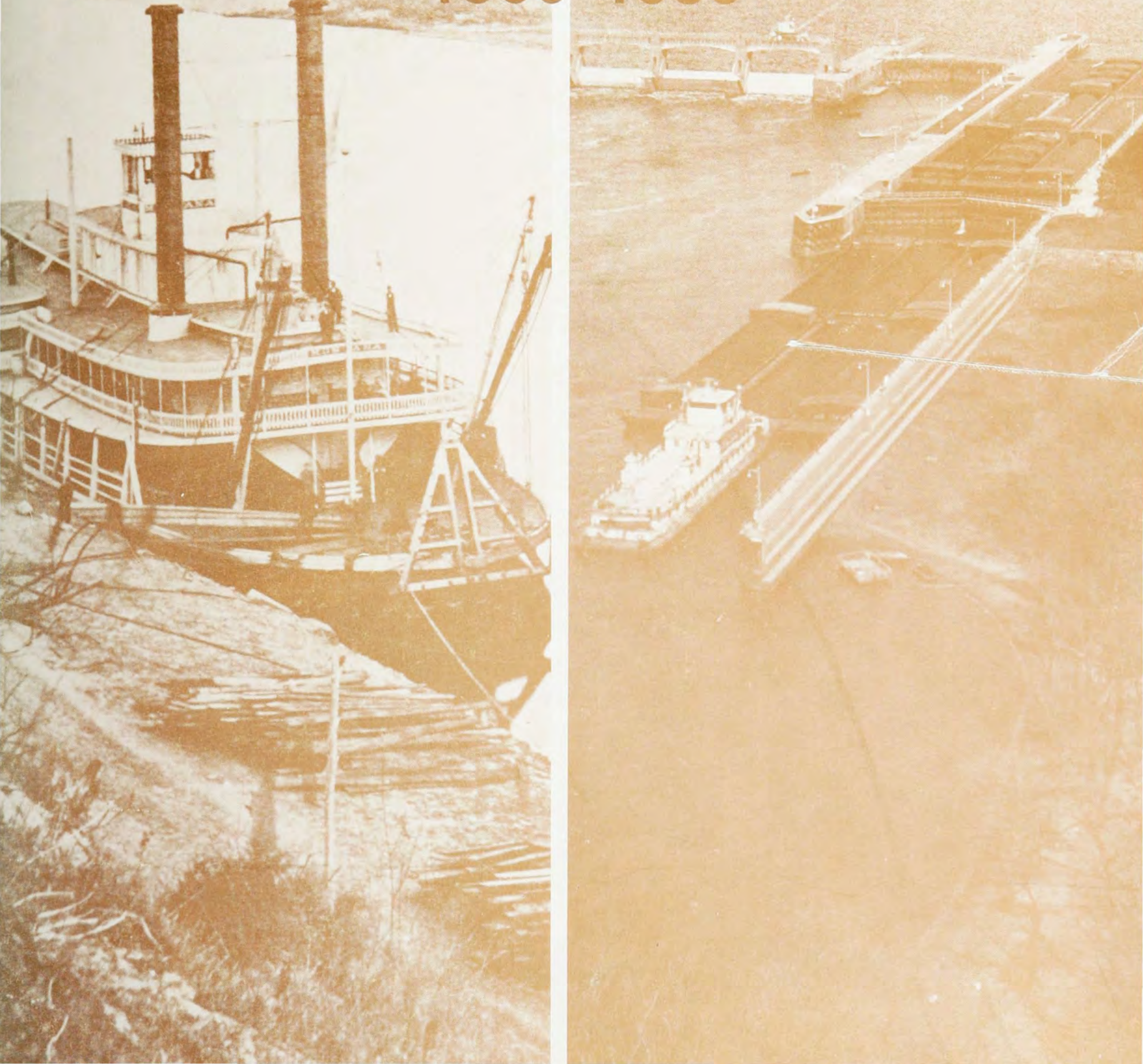
A HISTORY OF THE ROCK ISLAND DISTRICT U.S. ARMY CORPS OF ENGINEERS

1866-1983



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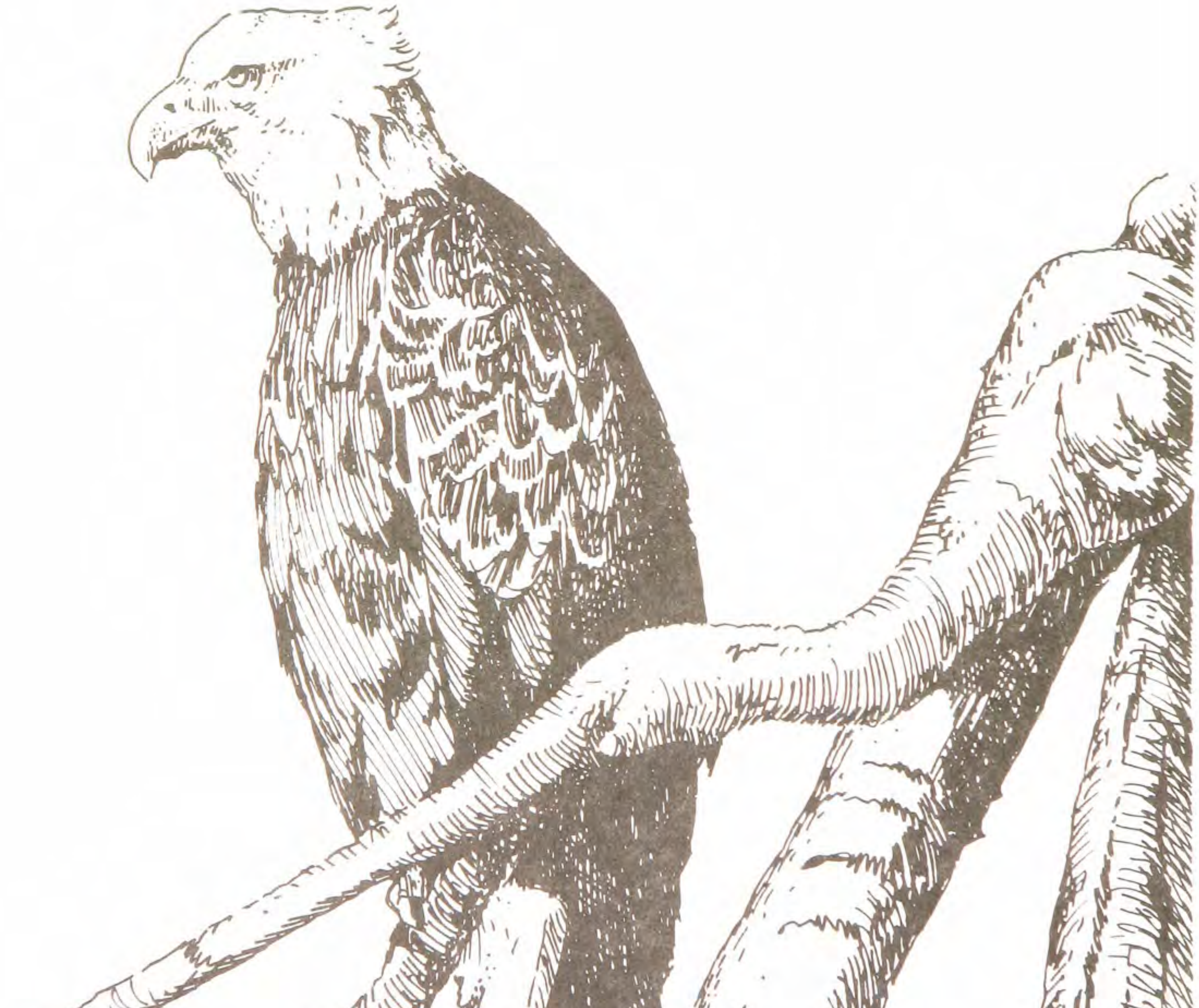

A HISTORY OF

THE ROCK ISLAND DISTRICT

U.S. ARMY CORPS OF ENGINEERS

1866-1983

By
Roald Tweet

U. S. ARMY ENGINEER DISTRICT, ROCK ISLAND
ROCK ISLAND, ILLINOIS
1984

Foreword

The Rock Island District's service to the public officially began in 1866 when the first District Office was established in Keokuk, Iowa. Since those early days when the District was almost entirely concerned with maintaining navigation on the Upper Mississippi River, the scope of our capabilities and responsibilities has increased progressively to meet the needs and judgments of the ultimate beneficiary of these services - the US citizen.

Dr. Tweet added a significant amount of new material and updated his already excellent history of the Rock Island District in this volume. It describes with authority a variety of activities that collectively constitute a significant contribution to the wise use and preservation of this Nation's water resources.

BERNARD P. SLOFER
Colonel, Corps of Engineers
District Engineer

Preface

The story of the Corps of Engineers on the Mississippi River above St. Louis began shortly after the Louisiana Purchase in 1803 with the first tentative exploration by Major Stephen H. Long. Sporadic at first, the work of improving the channel of the Upper Mississippi became a permanent job in 1866 with the beginnings of the Rock Island District. This volume attempts to survey those early years of trial and experiment and provide a more detailed account of the growth and development of the Rock Island District from 1866 to the present.

While I have attempted to be accurate and detailed in presenting the basic questions of what happened and when, I have consciously expanded this history in three directions. Because I found that many present Corps employees were interested in, but had little knowledge of, early techniques of channel improvement, I have spent some time describing *how* things worked. Because I discovered that the public often viewed the improvements as whims dictated by the self-interest of the Engineers, I have introduced some economic, commercial and cultural background to explain *why* improvements took the shape they did. For example, I have attempted to show that the nature of the river and the needs of the steamboats determined the kind of improvements far more than did West Point textbooks or Corps politics. And because I found that the practical visions of the District Engineers and their civilian employees had as much to do with the success of the work as Congressional appropriations, especially in the 19th century, I have considered the people involved as much as the policies and machines.

My research for the first edition of this history in 1973-74 found many important documents to be missing, hidden, or destroyed, leaving many minor and several large gaps in the historical record. This frustration has been made up by the generous and understanding help I received from current and

past employees of the Rock Island District, all of whom were not only friendly, but open and candid. Robert Clevenstine, Frank Ashton, Raymond Stearns, and Joseph Gerdes provided invaluable supplements to the rather terse information in the *Annual Reports* from 1930 on. Mr. William Verlinden spent several months assembling documents from scattered offices and old corners before I began my research, and he pointed me in many right directions. Franklin J. Ryder of the St. Paul District graciously opened his files and his research to me. Thanks is also due to Howard Stamer whose liaison work helped pull the whole book into shape.

The excellence of the photographs which accompanied the text in the first edition and which have nearly all been carried over to this new edition is almost entirely due to the interest and craftsmanship of three men in the Rock Island District photo lab: Wayne Piatt, Virgil Heitman, and Robert Carstens. The present edition has also been enhanced by the work of Loren Carey, Chief, Drafting and Illustrating Section, who has been primarily responsible for the design and layout of the book, and who has contributed several new drawings and other illustrations.

I owe special thanks to Richard S. Gustafson, Chief of the Public Affairs Office, who has now guided my work through two editions. Two other employees of the Public Affairs Office have been especially helpful in the preparation of this new edition. Ray Gall has tracked down information and located records which have helped fill in many blanks in the first edition. Betty Montag's careful readings of the manuscript have gone far beyond correcting typos to save me from many linguistic and factual errors.

The first edition of this history began in 1973 under the direction of Dr. Jesse Remington, then Chief of the Historical Division, Office of the Chief of Engineers. Dr. Remington's enthusiasm was catching and his careful reading of the manuscript both as an historian and as a reader unfamiliar with

the Upper Mississippi Valley resulted in greater accuracy and clarity. This new edition has benefitted greatly from a detailed reading by two representatives of the Historical Division: Dr. John Greenwood, Chief, and Dr. Martin Reuss. In places where I was not a very professional historian, they were.

Many people and organizations outside the Corps of Engineers were also of great help. The Davenport, Iowa, Putnam Museum contained much information not found elsewhere, as did the Iowa State Historical Society in Iowa City. Mr. Elmer Parker of the Old Military Branch of the National Archives patiently introduced me to the intricacies of those record collections. Dr. William Roba of Davenport, Iowa, served as a research assistant for the sections on floods and flooding. Finally, without a sabbatical leave from Augustana College during the 1972-73 school year, I could not have found the time to write this history; without the College's forebearance many times since, when research interfered with teaching, I could not have revised it for this new edition.

The most pleasurable and satisfying part of this project for me has been the opportunity to do it again and, hopefully, do it better. This edition is about one-third longer than the first edition. That one-third not only covers the five years since the first edition was published, including the expansion of the District to include the Illinois Waterway, it incorporates many pieces of the history which have surfaced since 1975. These missing pieces have corrected the text in many places and added to it in others, broadening and deepening my sense of the "story" contained within the history of the Rock Island District. My hope is that the reader may find some of this sense of story related in the following pages.

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Prologue

The River and the Rock Island District

On June 17, 1673, Father Marquette and the explorer Joliet led their expedition around the last gentle sweep of the Wisconsin River, beneath the Wyalusing bluffs on the left, past the plains on which the town of Prairie du Chien would be built on the right, out into the wide channel of the Upper Mississippi River. Behind them lay not only the remote outpost of Green Bay, but a tangled string of speculation and intrigue that had pulled down fortunes, political positions and heads all the way back to the French court. La Salle had personally lost two fortunes, and had escaped with his life only by killing his enemies first—all because of rumors during the 1660's of a great river to the west.

For Marquette and Joliet, this was not just another river. They were filled, Marquette wrote, "with a joy I cannot express."[1] But the Mississippi had other ideas that June 17. As the lead canoe carrying the two explorers entered the channel, it rammed a great catfish and nearly upset. Grand as this moment of discovery was, the Mississippi—always an independent river with work to do—could not stay for the occasion.

During the following weeks, Marquette and Joliet slowly drifted down the river, visiting friendly Indian villages, wondering at the unexpected beauty of the shoreline, until they had come within 700 miles of the river's mouth. Here, having demonstrated to their own satisfaction that the Mississippi did indeed empty into the Gulf of Mexico, they returned, passing up the Illinois River, across to Lake Michigan, and up along the western shore to Green Bay. It remained for those who followed—other explorers, hunters, trappers, traders, lead miners, settlers—to realize the full extent and importance of the Upper Mississippi River.

From north-central Minnesota to Cairo, Illinois, the Upper Mississippi follows a winding course of some 1,260 miles, partially forming the borders of Minnesota, Wisconsin, Iowa, Illinois, and Missouri. At its source in Lake Itasca the Mississippi is a mere stream twelve feet wide and two feet deep. By the time it reaches the Falls of St. Anthony at Minneapolis, it has become a navigable river. Between Minneapolis and St. Louis the Mississippi grows with water from the Minnesota, the St. Croix, the Wisconsin, the Rock, the Des Moines, and the Illinois Rivers, along with numerous lesser streams.

Just above St. Louis the Mississippi meets the Missouri River, muddy with brown silt from 3,000 miles of western plains. At this point the character of the Mississippi begins to change, a change that is complete when it receives the water of the Ohio River at Cairo. From here on it becomes the Lower Mississippi, the "mile-wide tide, shining in the sun" made famous by the stories of Mark Twain.

The Upper Mississippi is not old as rivers go, but it has worked hard. From Minneapolis and St. Paul to St. Louis, it has scoured and polished a 660-mile valley through which it now flows, hemmed in by bluffs and palisades that tower above it by as much as 500 feet. This valley is seldom more than one or two miles wide until the river passes over the Des Moines Rapids near Keokuk, Iowa. In southwestern Wisconsin and northeastern Iowa, the "little Switzerland of America" its residents call it,

wooded bluffs reach right to the water's edge, leaving the width of only a block or two for towns squeezed along the shore.

The distinctive beauty of the Upper Mississippi Valley was remarked upon by the earliest trappers and explorers. By the middle of the 19th century when regular steamboat traffic had been established on this stretch of river, it had become fashionable for upper-class families from St. Louis and the East to take the grand tour upriver to the Falls of St. Anthony. George Catlin, the American painter, who spent several seasons along the Upper Mississippi, first urged this tour on the American public in 1835. The first (and almost only) example of cooperation between steamboatmen and the railroads was the promotion of organized rail-water tours in the 1860's and 1870's. Tourists were brought from the East Coast by rail to Rock Island, Illinois, where they boarded steamboats for the trip north. On some of the steamers, fashionable tourists on the upper decks frequently outnumbered the immigrants and settlers packed in beneath.

On these excursions up the river, tourists passed places whose names were as fanciful and varied as their features: Maiden Rock, Catfish Creek, Point-No-Point, Bogus Bay, Grandad's Bluff, Sugar Loaf, Pig's Eye Island, Beef Slough, Bullet Chute, Dogtown Day Mark, and Royal Arch.

They also passed points where history had already been made: the site of Fort Armstrong guarding the foot of Rock Island; Campbell's Island, where the westernmost battle of the War of 1812 had been fought; Fort Crawford at Prairie du Chien, where Colonel Zachary Taylor and Lieutenant Jefferson Davis served together in the late 1820's; Bad Axe, Wisconsin, where in 1832 the Black Hawk War came to an end in an ignoble battle, but one which opened the Upper Mississippi Valley to settlers; coming at last to the Falls of St. Anthony, named by Father Louis Hennepin in 1680 on one of LaSalle's expeditions.

A trip on the Upper Mississippi became a must for many European visitors who came to America in the 19th century to examine, comment on, and be properly disgusted by our quaint customs. Many Europeans agreed with Charles Dickens, who found everything about the Lower Mississippi—climate, customs, food, and water—disagreeable. Others, however, were pleasantly surprised. Anthony Trollope, the English novelist, visited the Upper Missippi in 1861 during the Civil War. Although he found American manners laughable, as he had anticipated, he was unexpectedly moved by the landscape. Trollope made the trip in October when the hardwood forests on the bluffs were at their best. In his book on America he wrote:

> I protest that of all the river scenery that I know, that of the Upper Mississippi is by far the finest and the most continued. One thinks of the Rhine; but according to my idea of beauty, the Rhine is nothing to the Upper Mississippi . . . Bluffs rise in every imaginable form, looking sometimes like large straggling unwieldy castles, and then throwing themselves into sloping lawns which stretch back away from the river till the eye is lost in their twists and turnings.[2]

As striking as the beauty of the Upper Mississippi is, however, it does not compare in importance to the river's work. The Mississippi has always been at work. Long before man arrived to use the river, it had drained the waters of four glacial ages, carving at least three separate channels in the process. It formed a drainage basin reaching into 42 of the United States. Over thousands of years, sediment from this vast basin formed a broad, flat plain from the original mouth of the river near present-day Cairo, Illinois, over a thousand miles south to the Gulf of Mexico.

When humans came the Mississippi did their work, too. Long before Europeans arrived, prehistoric woodland Indians used the river and its tributaries for food and transportation. Indian settlements along the Mississippi traded goods over virtually the entire continent via this intricate waterway network. Later, the Spanish, French, British, and finally Americans used the river as a highway for settlement, commerce, and war. Canoe, pirogue, raft, flatboat, keelboat, and paddle-wheeler hauled lead from the mines at Dubuque and Galena,

carried troops as far north as Fort Snelling, and brought furs and farm produce down to markets at St. Louis and New Orleans. Beginning in the 1830's, thousands of immigrants and settlers from the East and the South came upriver from St. Louis and Rock Island to debark at Guttenberg and Lansing, Iowa, to settle the rich farmlands of the Midwest. Down this river, too, between 1850 and 1918, came virtually every usable white pine log in the states of Wisconsin and Minnesota. Work related to the river built 100 towns between St. Paul and St. Louis.

With few exceptions, the Indians, the early explorers, and the traders and trappers used the river as they found it, adapting their boats to the demands of the river. As settlement and commerce along the river grew, however, the limitations of the Upper Mississippi became more obvious and frustrating. Rapids, constantly shifting sandbars, dramatic shifts in water levels from floods to almost dry channels made the river both dangerous and undependable—especially for the larger boats used by the Europeans. By the time of the Louisiana Purchase in 1803, "river improvement" had become a frequent topic of conversation among the boatmen who used the river. It remained for the young Republic, whose land this now was, to slowly do the actual improvement.

In the process of adapting the Mississippi River to these new needs, no organization played so great a part as the United States Army Corps of Engineers. On the navigable section of the Upper Mississippi from Minneapolis south to St. Louis, the very shape of the channel is largely the result of the activities for over 100 years of the Rock Island District. To promote the welfare and commerce of the towns and farms along the river, engineers of the Rock Island District have helped construct a series of navigation locks and dams, and have contained flood waters by a growing network of urban and rural levee systems.

If the tamed Upper Mississippi today is not the same pristine river it was when the Sac, Fox, and Ojibway Indians lived on its banks, the long slack

water pools behind the dams, dotted with thousands of willow and oak-covered islands and sand bars have given the present river a new beauty all its own.

Nor has the change all been one way. As the Corps of Engineers has shaped the river, they in turn have been shaped and adapted to the demands of the river. Early in its history of civil improvements, the Corps recognized that no two waterways were alike. The Office of the Chief of Engineers embarked on a policy of decentralization which permitted each district some sharing in shaping its organization and procedures to suit its own individual problems.

As one of the earliest engineer districts, the Rock Island District has had to find its way, experimenting, developing new techniques for new problems. The Upper Mississippi, with its shifting, sandy bottoms and narrow flood plain, helped determine both the pace of river improvements and the methods used. And like the river, annual appropriations from Congress for improvement work have swung back and forth between periods of high and low water, permitting the work of the District to expand or forcing it to contract. The following pages tell the story of the Upper Mississippi River and the Rock Island District Corps of Engineers, and of how they have shaped each other.

The Rock Island District

The beginnings of the Rock Island District can be traced back to the Act of June 23, 1866, which appropriated funds for the first sustained attempt to improve navigation on the Upper Mississippi River. At this time there were no districts as such within the Corps of Engineers. Early improvements on the Western rivers were assigned by projects rather than districts, permitting several Engineer officers to be assigned to different duties within the same general area.

Records in the Rock Island District Office indicate that until World War I, District Engineers considered the Rock Island District to have begun in June 1878, when Congress passed the 4½-foot channel project, the first comprehensive plan to improve the whole 660 miles of river between St. Louis and St. Paul.[3] Colonel Alexander Mackenzie, who arrived to superintend the 4½-foot project in 1879, was the first to refer to himself as a District Engineer. But not until January 1892, when Colonel Mackenzie was assigned all of the Corps operations from St. Paul to the mouth of the Missouri River, did the concept of superintending specific projects give way to the idea of supervising an area or district. Not until 1908 did the term "District" come into official use as a heading in the *Annual Report of the Chief of Engineers.*[4]

Nevertheless, the arrival of Lieutenant Colonel James H. Wilson at Keokuk, Iowa, in August 1866 marked the beginning of continuous improvement work on this section of the Mississippi, and so it seems appropriate to mark that event as the beginning of the future Rock Island District and to consider Colonel Wilson as its first District Engineer.

Wilson's orders were to superintend the improvement of the Des Moines and Rock Island Rapids, and to make examinations and surveys toward possible improvement of navigation on the Rock and Illinois Rivers. During his four-year tenure in office, he planned and directed the construction of a lateral canal along the Iowa shore to by-pass the Des Moines Rapids, and he began the excavation of a four-foot channel through the Rock Island Rapids. He surveyed and prepared improvement plans for both the Rock and Illinois Rivers. In 1870 Wilson was further ordered to make a preliminary survey for an Illinois-Mississippi canal which would connect the Illinois River near Hennepin with the Mississippi River at Rock Island. These several projects remained major responsibilities of the Rock Island District throughout much of its history.

In October 1870 Wilson was relieved by Colonel John N. Macomb, who had been Superintendent of


MINNESOTA
WISCONSIN
IOWA
ILLINOIS
MISSOURI
MADISON
WATERLOO
DUBUQUE
ROCKFORD
CHICAGO
LOCKPORT LOCK
T. J. O BRIEN L. D.
DES MOINES
DAVENPORT
ROCK ISLAND
JOLIET
BRANDON ROAD L. D.
STARVED ROCK L. D.
MARSEILLES L. D.
DRESDEN ISLAND L. D.
BURLINGTON
PEORIA
PEORIA L. D.
KEOKUK
LA GRANGE L. D.
QUINCY
HANNIBAL
SPRINGFIELD
SAYLORVILLE LAKE
LAKE RED ROCK
CORALVILLE LAKE
IOWA RIVER
CEDAR RIVER
WAPSIPINICON RIVER
ROCK RIVER
FOX RIVER
SKUNK RIVER
DES MOINES RIVER
ILLINOIS RIVER
SANGAMON RIVER
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Western Rivers Improvements since 1866. Macomb had already, in June, relieved Major Gouverneur K. Warren of his duties on the Upper Mississippi: surveys and experimental improvements of the Upper Mississippi, Minnesota, and Wisconsin Rivers, and construction of a new railroad and wagon bridge at Rock Island to replace the old railroad bridge which had been a navigation hazard.

In order to be near the construction site of the bridge, Colonel Macomb transferred the work of Major Warren's St. Paul Office and of Colonel Wilson's Keokuk Office to the U.S. Engineer Office in Rock Island, which had been established by Wilson as a sub-office in 1869. Macomb also retained his former responsibilities for snagging operations on the Upper Mississippi, so that with his arrival as District Engineer, the duties of the Rock Island Office were vastly broadened in scope and area. Two steamboats, the *Montana* and the *Caffrey,* bought by Warren and modified for his dredging experiments, were transferred to Rock Island, along with several quarterboats and other smaller craft.

In 1872 a Board of Engineers convened at Minneapolis to investigate the deteriorating condition of the Falls of St. Anthony. As a result of this investigation, the Chief of Engineers assigned Macomb the task of preserving this important and historic falls. In 1874 Macomb received additional survey duties connected with the Transportation Routes to the Seaboard project and with the Survey of North and Northwestern Rivers.

Within ten years of their arrival, then, Engineers of the Rock Island Office were performing a wide variety of navigation improvements on the Upper Mississippi: constructing a canal and locks, snagging, dredging sandbars, chiseling and blasting rock, saving a famous falls, and surveying not only the Upper Mississippi, but most of its tributaries as well.

A similar expansion of duties in the Rock Island District occurred when Major Francis U. Farquhar

The Rock Island District, as of July 1, 1980, covers 78,000 square miles in a rough triangle running from south-central Minnesota to the Indiana border, covering parts of five states. The District is responsible for 314 miles of the Mississippi River and 268 miles of the Illinois Waterway, as well as three Iowa reservoirs and all of the rivers and streams which drain into these main systems.

replaced Macomb as District Engineer in November 1877. Major Farquhar had been stationed at the U.S. Engineer Office in St. Paul, in charge of improving the Mississippi River above the Falls of St. Anthony, and of improvements on the Minnesota, St. Croix, and Chippewa Rivers, and the Red River of the North. He was also in charge of the projected construction of the first lock and dam on the Mississippi at Meeker's Island. Major Farquhar retained these duties when he assumed those of Macomb. This gave the Rock Island Office jurisdiction over navigation improvements from Moorehead, Minnesota, on the Minnesota-North Dakota border, to the mouth of the Illinois River, with sub-offices staffed by assistant engineers at St. Paul and Keokuk.[5]

At the same time that Major Farquhar assumed command of Macomb's projects, Captain Amos Stickney, who had been in local charge of the newly-opened canal around the Des Moines Rapids at Keokuk, was given separate command of that project. Captain Stickney remained in charge of the Canal until November 1881, when it was returned to the Rock Island Office. The Des Moines Rapids Canal was put under Montgomery Meigs, a United States Civil Engineer, who served the Rock Island District well until he retired in 1926.

The assumption of Colonel Macomb's duties by Farquhar marked the first of several times that Rock Island came near to losing its Engineer Office. Major Farquhar intended to transfer the duties of the Rock Island Office to St. Paul.[6] He decided to keep the office at Rock Island open until after passage of the next River and Harbor Bill, and put Montgomery Meigs in local charge at Rock Island while he remained in St. Paul during the winter.

The move never took place. By April of 1878, Farquhar had instead moved to Rock Island. The Act of June 18, 1878, authorized a 4½-foot channel between St. Paul and St. Louis. On July 15, 1878, the Chief of Engineers transferred all of Major Farquhar's duties above St. Paul to Captain C. J. Allen at the U.S. Engineer Office in St. Paul. Being centrally located for the extensive new 4½-foot project, Rock Island retained its engineers.

Another change in District boundaries occurred shortly after the arrival of Major Farquhar's replacement, Captain Alexander Mackenzie, in June 1879. Mackenzie had charge of the 4½-foot channel project from St. Paul to the mouth of the Illinois River. In November 1881, with the transfer of Captain Stickney to the New Orleans Office, Mackenzie assumed command of the Des Moines Rapids Canal. During these years the idea of the area between St. Paul and St. Louis as a district gradually developed. Additional sub-offices with civil engineers acting as assistants were assigned to sections of the river.

Then, in 1884, the Mississippi River Commission, established by Congress in 1879 to deal with problems of navigation on the Lower Mississippi, was given charge of all improvements below the Des Moines Rapids. In September 1884 the Commission placed Captain Ernest H. Ruffner, Corps of Engineers, in charge of improvements from Keokuk to the mouth of the Illinois River. Captain Ruffner opened an office in Quincy, Illinois, to supervise this work, leaving Mackenzie with a shortened St. Paul-to-Keokuk District.

When Captain Ruffner was transferred in 1892, the works of the Quincy and Rock Island offices were again consolidated at Rock Island under Mackenzie.

Two other small changes in district boundaries occurred under Major Mackenzie. The Act of August 11, 1888, extended the upper limit of the Rock Island District from St. Paul to the Washington Avenue Bridge at Minneapolis. Though small in distance, this change put Major Mackenzie in charge of planning for locks and dams 1 and 2. This section was returned to the St. Paul District in 1897.[7] The Act of July 13, 1892, extended the lower limits of the District from the mouth of the Illinois River to the mouth of the Missouri River.

As was the case with his immediate predecessor, Major Mackenzie made several attempts to move the Rock Island Office away from Rock Island. In

April of 1881 he requested the Chief of Engineers to change his station to St. Paul because the Rock Island location was "unhealthy."[8] Rock Island was in the middle of an extensive flood at the time; cholera and typhoid were constant threats, especially to Corps employees working on the river. There had also been a major flood the previous spring, with the highest water ever known on the Upper Mississippi.[9]

Major Mackenzie's request to rent an office in St. Paul was approved. In October 1881 he requested funds for office furnishings, including an iron safe to hold District records, but apparently the final transfer was not included.

Again in 1882 Major Mackenzie made several requests to the Chief of Engineers to close the Rock Island Office. In a series of letters from spring through fall, he requested that, for many reasons of economy, the Rock Island and Keokuk offices be consolidated at Keokuk, the "location of the largest and most important individual work under my charge."[10] On one of these letters requesting a transfer, dated September 23, 1882, there is a penciled notation from the Chief of Engineers which reads "Wait until he asks again—after passage of R and H Bill."[11] Evidently Major Mackenzie did not ask again, for he settled down to an extremely cordial and productive stay in Rock Island. He remained as District Engineer for 16 years, far longer than any other Engineers in the Rock Island District. He went on to become a Major General and Chief of Engineers (1904-1908). During World War I he came out of retirement to return to Rock Island as District Engineer for two more years.

One other change took place while Major Mackenzie was District Engineer. In 1888 the Corps of Engineers in the continental United States was divided into five divisions in order to facilitate the increasingly complex responsibilities of the Corps' civil works. The Rock Island District became a part of the Northwest Division under Colonel Orlando M. Poe.

Since then, because of organizational adjustments, the Rock Island District has been a part of the Western Division, the Upper Mississippi Valley Division, and is presently a part of the North Central Division headquartered in Chicago.

During the first part of the 20th century, the borders of the Rock Island District continued to change somewhat erratically. In 1901 the lower four miles of the Illinois and Mississippi Canal, which had been built by the Second Chicago District, was turned over to the Rock Island District to operate and maintain. Snagging duties on the Illinois River from its mouth to Peoria were resumed by the Rock Island District in 1907. In 1909 this snagging operation was expanded to include the Minnesota, Chippewa, St. Croix, Black, and Rock Rivers.

A new kind of duty was assigned the Rock Island District in 1910 when the Lighthouse Board was dissolved. The lighthouse tender *Lily* was transferred to the District, and with it charge of lights and channel markers from St. Paul to Cairo on the Mississippi, as well as the lights along the entire Illinois and Missouri River systems, and a few lights on the Minnesota, Osage, and Gasconde Rivers. Appropriations for this service came from the Lighthouse Service rather than the Corps of Engineers, but until President Roosevelt assigned lighthouse duties to the Coast Guard in the mid-1930's, the headquarters of the 13th Lighthouse District was the Engineer Office in Rock Island, and the duties were carried out by Corps employees using District boats.

In 1911 the Second Chicago District was dissolved and its duties divided between the Chicago and Rock Island Districts. By this division, the Rock Island District was given charge of operation and maintenance of the remaining 71 miles of the Illinois and Mississippi Canal. Rock Island operated the Canal until 1950, when it was closed to traffic, and maintained it until 1970, when the Canal property was transferred to the State of Illinois for use as a recreation area.

As the complexity of work within the District increased with the authorization of the 6-foot channel project in 1907 and the 9-foot channel project in 1930, the size of the District was gradually decreased. In 1919 the portion of the Upper Mississippi between St. Paul and the mouth of the Wisconsin River was transferred to the St. Paul District. In 1933 the lower limit of the District was moved up to Clarksville, Missouri, 55 miles above the mouth of the Illinois River. Finally, in 1936, shortly after the Rock Island District had completed construction of Lock and Dam 10 at Guttenberg, Iowa, the boundaries were further reduced to their present size: from just below Lock and Dam 10 to, and including, Lock and Dam 22 at Saverton, Missouri.

With the completion of the 9-foot channel project, Rock Island District boundaries remained unchanged until 1980. On July 1, 1980, as a result of a Corps-wide district realignment study, all of the river-related responsibilities of the Chicago District were transferred to the Rock Island District. This change brought the Illinois Waterway System back to the Rock Island District, where it had begun under the supervision of Colonel Wilson in 1866 and where it had remained until it was transferred to Captain Garret J. Lydecker at Chicago in 1877.

For a brief period early in the 20th century, the Illinois Waterway was again supervised from Rock Island. On April 1, 1905, Major Charles Riche arrived in Rock Island to become District Engineer. He had been District Engineer of the Second Chicago District, where he had supervised construction of much of the Illinois and Mississippi Canal. One month later, on April 30, 1905, Major Riche again assumed command of the Second Chicago District, while retaining his responsibilities at Rock Island as well. From this point until the Second Chicago District was dissolved in 1911, the work of both districts was consolidated at Rock Island. In 1911, the Illinois Waterway was assigned to the Chicago District and the Illinois and Mississippi Canal to the Rock Island District.

The new area assigned to Rock Island in 1980 covers the Illinois Waterway from Lake Street in downtown Chicago and the Thomas J. O'Brien Lock on the Calumet River downstream to the La Grange Lock and Dam south of Beardstown, Illinois. Included in the area are six rivers—the Illinois, Chicago, Fox, Des Plaines, Kankakee, and Sangamon—as well as eight locks and dams.

The present Rock Island District is a rough triangle covering 78,000 square miles. It stretches from south-central Minnesota to the Indiana border, covering parts of five states: Minnesota, Wisconsin, Iowa, Illinois, and Missouri. Within this area the District is responsible for navigation and flood control, and more recently, for water quality, recreation, and wildlife along 314 miles of the Mississippi River and 268 miles of the Illinois Waterway. It is also responsible for all of the rivers and streams which drain into the Mississippi and Illinois Rivers within its boundaries, and for three large reservoir systems in Iowa.

Although the Rock Island District does not range as far today as it did in the 19th century, its duties are far more varied and complex than were the single-purpose projects superintended by Colonel Wilson, Colonel Macomb, and Major Farquhar. The increasing industrial, residential, and agricultural use of the Upper Mississippi flood plains, the introduction of multi-purpose, basin-wide planning, the development of inter-agency cooperation in water resource use, the vast increase in commercial barge traffic since the 1930's, and most recently, our growing awareness of obligations to our limited natural resources, have all contributed to provide new challenges for the Rock Island District in the endless job of arbitrating between the needs of civilization and the Upper Mississippi River.

Notes

Prologue

1. Francis Parkman, *The Discovery of the Great West: La Salle* (New York: Rinehart, 1956), p. 45.

2. Anthony Trollope, *North America* (New York: Alfred A. Knopf, 1951), pp. 143-44.

3. Reports of appropriations compiled by District personnel during this period show early appropriations applied to separate projects. Beginning in 1878, such appropriations are listed under "Rock Island District."

4. Major Warren's report for 1868 (*Annual Report*, 1869, pp. 43ff.) uses the term "District" in referring to his work.

5. The *Annual Report*, 1879, I, p. 690, lists 17 projects under Major Farquhar's supervision. The only project listed for what is now the St. Paul District is improvement of the Yellowstone River above the place where it meets the Missouri River.

6. Major F. U. Farquhar to Chief of Engineers, November 23, 1877, File 71, Letters Received, RG 77, National Archives (hereafter NA).

7. Construction of these locks is covered in Raymond H. Merritt, *Creativity, Conflict & Controversy: A History of the St. Paul District U. S. Army Corps of Engineers* (Washington, D.C.: U.S. Government Printing Office, [1980]).

8. Lt. Col. Alexander Mackenzie to Chief of Engineers, April 13, 1881, File 71, Letters Received, RG 77, NA.

9. The Davenport *Democrat Gazette*, May 11, 1888, p. 1, quotes Major Mackenzie as saying that this was the first reliably measured flood on the Upper Mississippi.

10. Lt. Col. Alexander Mackenzie to Chief of Engineers, October 9, 1882, File 71, Letters Received, RG 77, NA.

11. Lt. Col. Alexander Mackenzie to Chief of Engineers, September 23, 1882, File 71, Letters Received, RG 77, NA.

Chapter 1

The Steamboat Versus the Western Rivers

Nature was at her most perverse when she designed American rivers. After spreading a grand network of main stems and tributaries across the whole United States east of the Great Plains, she filled nearly every channel with such an assortment of snags, sandbars, shoal waters, rocks, rapids, and cross currents as to make navigation all but impossible for much of the year, and dangerous the rest of the time.

The Louisiana Purchase in 1803 highlighted this perversity. A seemingly limitless country lay waiting to be settled, with no good way of getting there. A few wagon trails could be made with great difficulty, but a system of roads seemed far away in the early 19th century. Meanwhile, there were the ready made Western rivers, free to everyone, barring the obstacles in their channels. Consequently, the first task facing the westward movement was the improvement of navigation.

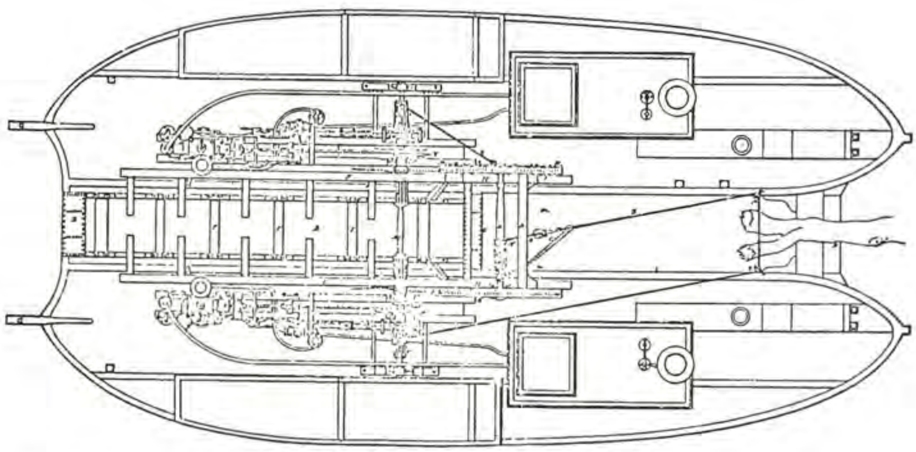
Such improvement took place in two stages. American inventors and tinkerers first applied

themselves to designing a boat which would overcome the obstacles in the rivers, or more often, simply adapt to them. The result of this tinkering was the rapid development of the western steamboat out of the eastern ship. At its highest development the steamboat was amazingly adept at navigating the unimproved waters of the Ohio and Mississippi Rivers, as well as nearly all of their tributaries. There was steamboat traffic on the Upper Minnesota River, the Des Moines and Cedar Rivers in Iowa, and on many streams like the Pecatonica in Illinois, which today is crossed by fences to keep cattle in. Rivermen told stories about legendary boats which could navigate on heavy dew or beer foam.

After the steamboatmen had brought the steamboat to its full potential, the only area for further improvement lay with the rivers themselves. At this point the Government, using the Corps of Engineers and the Topographical Bureau as its working arms, entered the scene. Beginning with isolated projects in the early 19th century, the Corps of Engineers gradually developed the inland waterways into a modern navigation system that is more in use today than ever before.

The development of the steamboat and the work of the Corps of Engineers in river improvement are inter-related. From the beginning of Corps surveys and experiments on the Mississippi and Ohio Rivers in 1819 down to World War I, the improvements made by the Engineers were designed almost solely to accommodate those floating, self-propelled gingerbread palaces. To understand much of the work of Engineers on the Upper Mississippi from 1829 to 1929, it is first necessary to understand the steamboat.

Robert Fulton's pioneer steamboat *Clermont* made its first successful trip in 1807. Within months, Fulton and his partner, Robert Livingston, had obtained an 18-year monopoly for their steamboat operation from Governor Claibourne of the Territory of New Orleans. Controlling the mouth of



SHREVE'S SNAG BOAT, PATENT No. 913, SEPTEMBER 12, 1838

AA': twin hulls
C: inclined bulkhead (iron-sheathed)
D: snag beam (iron-sheathed)
FF: rollers for removal of snag timber
G: main windlass chain
LL: inner engine shaft windlasses
M: engine coupling shaft
N: main windlass chain
R: gallows frame crossbeam
UU': outer engine shaft windlasses
XX: double steam engines
Z: inclined plane for disposal of snag timber

Henry Shreve's snagboat designed for the Ohio and Lower Mississippi Rivers. A succession of Shreve snagboats, built under contract to the Corps of Engineers, effectively cleared these rivers of sunken trees, one of the major obstacles to early navigation.

the Mississippi, of course, meant effectively controlling steam traffic on both the Mississippi and the Ohio—even before there were any steamboats to put there.

Fulton's and Livingston's interest in these western rivers had existed prior to the success of the *Clermont.* In developing his boat, Fulton had the West in mind from the very beginning. The extensive system of waterways tying the East to the Louisiana Purchase via Pittsburgh and Louisville seemed to be the only hope of bringing commerce, civilization, and cities to that rich but roadless territory.

River traffic on the Mississippi had already developed in response to those needs, but only by crude and slow rafts, flatboats, and keelboats. The rafts and flatboats were tacked-together floating woodpiles that were broken up once they had brought their supplies of fur or lead down to New Orleans. The keelboats went upriver again for more than one trip, and they went the hard way, pushed against the current by rows of men with long poles,

or pulled along the shore by ropes tied to upstream trees as they went. A keelboat could make the trip from New Orleans to the lead mines at Galena, Illinois, in one month. All of these boats were subject to the whims of the river and to uncertain crews of roustabouts.

This man-powered river traffic was never extensive. Prior to 1817 the whole commerce of New Orleans from the Upper Mississippi was about 20 flatboats of 100 tons each per year.[1]

Two years after the maiden voyage of the *Clermont,* Fulton sent a representative, Nicholas Roosevelt, to Pittsburgh with instructions to make a survey of the Ohio and Lower Mississippi Rivers. In 1809 Roosevelt and his wife floated down the Ohio in a flatboat observing, asking questions, making soundings, and even lining up coal mines for possible future use as fuel stops. Between Natchez and New Orleans the Roosevelts went by rowboat to better observe currents and sandbars. They arrived in New Orleans on December 1.

Rivermen laughed at the idea of a steamboat on these rivers filled with strong currents and shoal waters, but Roosevelt convinced the Fulton-Livingston group that it could be done. In the spring of 1811, with plans supplied by Fulton, Roosevelt set about constructing a wooden steamboat at Pittsburgh. This boat was the *New Orleans,* 148.5 feet long with a 32.5-foot beam and a 12-foot draft. Whether it was a sternwheel or sidewheel boat is uncertain. Contemporary accounts support both views. The *New Orleans* was a plain boat with a single deck, one cabin divided into two compartments, and a pilot house.

When the *New Orleans* reached Louisville on the night of October 1, 1811, rivermen had to admit that she worked—but, they said, she would never return against the current. Roosevelt planned a big dinner for his Louisville hosts. While they were eating, the engines began and before the guests could catch their surprise, they found themselves out in the channel going upstream.

From Louisville the *New Orleans* successfully managed the Falls of the Ohio (the water was high) and steamed toward New Orleans, only to be caught in the middle of the famous "night of horrors," the New Madrid Earthquake of 1811, the greatest earthquake ever to strike North America. Huge waves churned from shore to shore, the water of the Mississippi turned bright red, dense flocks of birds darkened the sky, and familiar landmarks disappeared as the river changed its course in numerous places. The *New Orleans* held her own and the next day, with the earthquake continuing, steamed on to New Orleans, reaching there on January 12, 1812.

Perhaps the earthquake was a fitting portent for the arrival of this first steamboat on the Mississippi, for within 20 years the steamboat completely changed the pattern of commerce on the river, and made possible settlement along the Mississippi Valley long before roads and railroads came to do the job.

The *New Orleans* was put into service in the New Orleans-to-Natchez trade. In 1814 she hit a stump near Baton Rouge and sank.

At this point a man arrived who was to become a legend both for his contributions to the steamboat business and for his pioneer work for the Corps of Engineers. Henry Shreve had become captain of his own flatboat at the age of 21. In 1810 he travelled to the lead mines at Galena, from which he took 70 tons of lead aboard keelboats down to New Orleans, where he cleared a profit of $11,000.

Shreve had examined the *New Orleans* and the second Fulton-Livingston boat, the *Vesuvius.* As a riverman acquainted with western rivers, he knew that these bulky boats were not the answers to easy transportation on the Mississippi.

The problem with these early steamboats was that they were designed in imitation of deep-water seagoing ships. They had rounded hulls with deep holds in which to carry the boilers. Like their ocean-going sisters, they had keels, which further in-

creased the draft without performing any real service for river navigation. And among other useless trappings, the *New Orleans* had portholes, a prow, and a long bowsprit. Other early steamboats retained masts. Finally, the engines of these early boats were not really powerful enough for the Mississippi current.

In 1814 Shreve became captain of the *Enterprise*, a boat built by Daniel French. With this boat Shreve intended to test another thing he found wrong with Fulton and Livingston: their monopoly on the Mississippi. In defiance of the monopoly, he arrived at New Orleans with the *Enterprise*, which was seized by court order. But at that moment New Orleans was under seige by the British, and General Andrew Jackson put Shreve into service transporting troops and material for the war effort. At the Battle of New Orleans, Shreve had charge of one of the field pieces that helped defeat a British column.[2]

Following the Battle of New Orleans, Shreve returned to the East determined to construct a boat, not according to preconceived notions of what a boat should be, but rather, a boat which took into account the nature of the river on which it was to be used. He also determined to use this boat to make a second attempt to break the Fulton-Livingston monopoly.

For several months Shreve isolated himself in a Brownsville, Pennsylvania, machine shop. He emerged with a radically new steam engine. It was horizontal rather than vertical; it had no flywheel and no condenser. It weighed a fraction of previous steam engines, yet it developed 100 horsepower. Finally, it was a high pressure engine where all previous steam engines had been low pressure.

Shreve had other surprises in store when it came time to install the engine in a boat. When a flattened hull, modeled along keelboat and flatboat lines, rose on the ways, critics asked how the machinery was going to fit. Shreve's answer was to put the boiler and engines on the deck rather than down in the hold. This left little room on the deck for freight or

passengers so Shreve added a second deck on top of the first one. He also divided the passenger cabin on this deck into separate rooms for the first time. He called these "staterooms" in imitation of the practice used on ocean-going ships, but he was the first to begin the practice of actually naming them after states.

Shreve's boat, the *Washington*, 400 tons, survived the laughter of critics and a disastrous boiler explosion on its maiden voyage in 1816 to break the steamboat monopoly and open the way for new ideas in steamboat design. Within a few years, the steamboat had reduced transportation charges to about ⅓ of their former keelboat and flatboat level.

Henry Shreve went on to spend most of his life in river improvement work. He was appointed Superintendent of River Improvement in 1827. In 1829, at the request of the Government, he designed and built the first snagboat for the removal of sunken logs. Such sunken trees, often stuck firmly in the river bed or still rooted there, were the primary obstacle to safe navigation on the Lower Mississippi. Shreve designed a sturdy, twin-hulled boat with machinery suspended between the hulls to winch out and cut up the snags. This boat, the *Heliopolis*, invited the same scorn and laughter from river men as his other inventions had, but it soon showed itself capable of handling both the snags and the laughter.

By 1838 Shreve had designed and built five more snagboats, adding innovations with each one. One of these, the *Eradicator*, was a light-draft, single-hull boat for use on the shallower Upper Mississippi where the huge double-hull boats could not go. After having developed and used snagboats over a period of ten years, Shreve, in 1838, obtained a patent on his fifth boat, the *Archimedes*. This action caused a falling out with Major Stephen H. Long when he became Superintendent of Western River Improvements in 1843. Long felt that Shreve had no right to such patents, since the twin-hull boat had been suggested to the Engineer Department as early as 1824, and since Shreve had designed and built all of his boats under Government contract

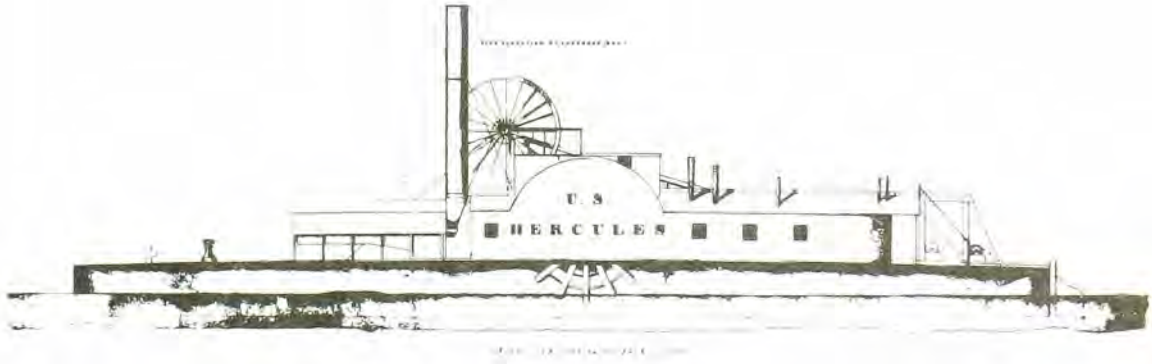
and at Government expense.[3] Long did admit, however, that many of Shreve's innovations were important to the removing of navigation obstacles on the Lower Mississippi.

In addition to inventing, or at least perfecting, the snagboat, Henry Shreve went on to undertake the removal of the Red River Raft, a monumental log jam some 150 miles long which blocked navigation on the Red River. Shreve removed the raft in record time, as far upriver as Shreveport, the town which he founded.

Meanwhile, the steamboatmen went on adapting their craft to the demands of the river. One humorist described the later boats as "an engine on a raft with $11,000 worth of jig-saw work."[4] Compared to ocean ships they were flimsy, quickly-built vessels with an extremely high accident rate and short life span. But during the golden age of steamboating in the 1840's and 50's, they far surpassed their Eastern relatives in the furnishings and decorations of their passenger cabins, in which the packet companies went to great lengths to outdo each other.

For the most part, however, the innovations and additions which today make pictures of those old boats so romantic and nostalgic stemmed from practical concerns. The delicate gingerbread beauty of the steamboat was due to the dictates of the Western waters on which they floated. There was very little theory behind the designs, and few boats were built from careful plans. Most boats were built from the hull up in a sort of freehand, the builder free to experiment and innovate as the vision of the boat took shape in his head.

As steamboat design advanced, the hull lost more and more depth and grew flat, to move on the water rather than in it. The superstructure grew higher and higher partly to give the pilot the ability to see ahead of the boat far enough to maneuver through bends and around bars in time, and partly to increase carrying capacity. Even the romantic paddle



Views of the United States snagboat *Hercules*, designed by Colonel Stephen H. Long in 1846. Twin-hulled snagboats such as this were too large for operations on the Upper Mississippi.

wheel was a product of river necessities, the channel in many places being too shallow for propellers.

Fully developed, the steamboat had three decks: main, boiler, and hurricane. Above these decks rested a shorter, narrower cabin called the Texas "because it was annexed," and atop this was the pilot house. The tall handsome smoke stacks of the boats were designed to carry sparks high above the flammable wooden decks.

Another distinctive feature of the Mississippi steamboat was the guards, extensions of the main deck beyond the hull sides. At first these extensions served to protect the side wheels. They kept banks and snags away from the fragile paddles and served as braces for the wheel shafts. Quickly, however, builders took advantage of this extra space and soon the whole first deck was built way beyond the hull, giving the largest steamers their characteristic impression of floating just above the water surface with no visible hull.

The steamboat by 1850 was able to carry incredible amounts of cargo on an unbelievable shallow draft. The first boats such as the *Enterprise* could carry about half their weight in cargo. By the 1880's, a few boats on the Upper Mississippi were carrying twice their rated tonnage.

Many of them did this on mere inches of water. The shallow channel above St. Louis challenged builders to produce a mosquito fleet capable of going up tributaries that today are difficult for a canoe. In 1867, the year following the beginning of the Rock Island District, two boats were constructed for the Upper Mississippi trade which drew 16 and 18 inches of water, though they displaced 220 and 280 tons, respectively.

If these boats were flimsy and dangerous, their profits were more than enough to make it worthwhile. A boat might cost its owner $50,000, but it could pay for itself in two trips up and down the river. In the 19th century, the average life of a seagoing vessel was 20 years; that of a whaling ship was 40 years; but down to 1850, when the Government began to inspect and license boats, the average life of a steamboat was less than five years. At the beginning of 1849, only 22 of the 572 steamboats operating on Western waters were more than 5 years old.[5]

While the steamboat trade developed rapidly on the Lower Mississippi and the Ohio as far up as Louisville, the beginnings of steamboat traffic to St. Louis and further north took several years longer. Here the Mississippi was shallower, the current swifter, and the sandbars more frequent. Rivermen assumed that no steamboat could ever navigate the rapids at Keokuk and Rock Island. In addition, the Upper Mississippi Valley was only sparsely settled until the 1840's.

Not until 1817 did a steamboat make its appearance on the Mississippi above the mouth of the Ohio. In August of that year the *Zebulon M. Pike* steamed up to the foot of Market Street in St. Louis. The *Pike* was the second-smallest steamboat documented on the Mississippi, a small craft of 31 tons.[6] It had one smoke stack and was so underpowered that it required supplemental poling in strong currents.

Two years later, in 1819, the *Western Engineer*, constructed and commanded by Major Stephen H.

Long, went up the Missouri River on an exploring expedition. When it returned to St. Louis in 1820, Long took the boat upriver to the foot of the rapids at Keokuk.

The *Western Engineer* was not only the first steamboat north of St. Louis, it was also undoubtedly the strangest. It was a small boat, 75 feet long with a 13-foot beam, drawing 30 inches of water. Her bow was constructed to resemble a scaly serpent rising out of the water, appearing to carry the boat on its back. The smokestacks were so arranged that smoke and steam came out of the serpent's mouth. The churning stern wheel further heightened the effect of a sea serpent carrying men on its back. The *Western Engineer* awed several Indian villages, which perhaps was one of its purposes. Those not frightened by the river dragon could be impressed by the three brass cannon mounted on the roof of the cabin, or the portrait of a white man and an Indian shaking hands.[7]

Until 1823 rivermen continued to assume that steamboats would never pass the Des Moines Rapids at Keokuk. In that year, however, a boat named the *Virginia*, 120 feet long, with a 22-foot beam and a 6-foot draft—little larger than a keelboat—made the trip carrying a prototype steamboat cargo of military supplies, tourists, businessmen, Indians, and soldiers.

Fortunately for historical record, one of the tourists on the *Virginia* was Giacomo Beltrami, the Italian exile and explorer who was at the moment interested in discovering the source of the Mississippi. Count Beltrami kept careful notes of the whole trip. Also on board was Great Eagle, a Sauk Chief, and Major Lawrence Taliaferro, the Indian Agent from Fort Snelling.

The *Virginia* left St. Louis on May 2, 1823. Beltrami was amused by the fact that as soon as the boat left the dock, Great Eagle, who had come to St. Louis to confer with General Clark (of Lewis and Clark fame), removed his uniform and made the rest of the trip "*in status quo* of our first parents."[8]

If the *Virginia* set a record for speed on the Upper Mississippi, it was only because she was the first boat there. On the 9th of May while the boat was taking on wood, Beltrami went for a walk in the woods. Returning to find the boat gone on without him, he walked upstream until he came around a bend and found her stuck in one of her frequent encounters with a sandbar. A bit further upstream Great Eagle got into an argument with the captain over which channel to take. He grew angry and swam ashore, where some of his people had been following the boat's progress along the shore. The next day when the boat arrived at Fort Edwards at the foot of the Des Moines Rapids, Great Eagle was already there.

After running the rapids with difficulty and "great good luck," the *Virginia* continued upriver. Beltrami found this section of the river a place of incredible beauty. The river "reflected the dazzling rays of the sun like glass; smiling hills formed a delightful contrast with the immense prairies, which are like oceans."[9]

On May 10th[10] the *Virginia* arrived at Fort Armstrong at the foot of the Rock Island Rapids on the lower tip of Rock Island. Her arrival caused excitement among the soldiers stationed there, who saluted the arrival with cannon. But on leaving the fort, the *Virginia* stuck fast on a rock in the upper rapids, and according to Beltrami, "had not Providence come to our aid and swelled the waters of the river for two days, the steam-boat would perhaps have remained nailed to the rock."[11]

The *Virginia* reached Fort Snelling at the mouth of the Minnesota River before turning around and coming back. That same summer in June she made a second trip between St. Louis and the Falls of St. Anthony.

For the next 20 years steamboating on the Upper Mississippi developed slowly. Galena lead mines contributed some traffic. In 1827, 7,000,000 pounds of lead came down to St. Louis from Galena, but some of this was still carried by keelboats. Most

steamboats above St. Louis at this time were chartered by the Government to transport military supplies to the string of forts along the river, or were hired by the American Fur Company.

By 1840 the populations of Iowa and Illinois began to boom. Between 1840 and 1860 Iowa went from a population of 43,112 to 674,913, while Illinois went from 476,183 to 1,711,951. Industry increased, too. By 1855 Moline, Illinois, was well known as a center of farm manufacture. John Deere plows were shipped by steamboat to Dubuque, Burlington, Muscatine, and Keokuk, Iowa.

Increased population and industry brought increased steamboat service. Arrivals of steamers at St. Louis from the Upper Mississippi went from 143 in 1841 to 663 in 1846. By 1854, the year the first railroad bridge across the Mississippi was begun at Rock Island, the Rock Island levee saw as many as 175 arrivals per month, with the average being 20 per week from March to December. In 1857 Davenport, Iowa, had 1,587 steamboat arrivals, 960 of these having Davenport as a terminus.[12]

Even the tributaries of the Upper Mississippi River developed steamboat traffic before the Civil War. By 1853 five steamboats were operating commercially on the Minnesota River, going to Mankato, Minnesota, on regular schedules. Several boats were built specifically for the Chippewa River trade.[13] Somewhat less regular service developed on the Iowa, Maquoketa, Cedar, Des Moines, and Rock Rivers by 1860. Between 1850 and 1860, 40 boats operated on the Des Moines River. In 1858-59, two of these maintained a regular schedule between Des Moines and Fort Dodge, Iowa.

During this same period, the logging industry grew to its status as an American legend. The two saw mills along the Mississippi in 1840 grew to nearly 100 by the end of the Civil War. Feeding these mills from the forests of Minnesota and Wisconsin were immense log rafts floated down river by a crew of 20 to 35 men, who worked, cooked,

and slept on the rafts. Composed of small units 16 by 32 feet tied together, a large raft might end up to be 300 feet wide by 1,600 feet long, containing up to 10,000,000 board feet of lumber. These long rafts had to be snaked and twisted through the river's S-shaped channels, a skill on the part of the raftsmen that today seems incredible.

During the early 1860's lumbermen began experimenting with the use of steamboats to take the log and lumber rafts downriver. Before this, their use had been limited to Lake Pepin, a wide section of the Mississippi between Minnesota and Wisconsin, where boats were needed to push the raft through the still current. Soon, steamboats were being designed specifically for the lumber trade. The first of these raftboats was the *J.S. Van Sant*, built in Le Claire, Iowa, by the Van Sant family of boat builders.

For 50 years, rafting traffic rivaled steamboating between St. Louis and St. Paul. Engineers who came to improve the river after the Civil War had to worry about the requirements of the rafts as much as of the steamboats. Canals, for instance, might be good for steamboats, but they weren't suited to the long wide rafts.

One other important steamboat innovation took place before the Civil War: the use of barges pushed by the boats. Pushing one or two barges (but still referred to as a *tow*boat), a steamer could add significantly to the tonnage hauled. By 1866, according to a contemporary riverman, Stephen Hanks, nearly every commercial steamboat used barges.[14] Many of these were being used for the bulk shipment of grain.

When Colonel Wilson and his assistants arrived on the Upper Mississippi in 1866, steamboats had become a regular and important part of the Valley economy. Nevertheless, steamboating was still slow, irregular, highly seasonal, and dangerous because of the two rapids, the shifting channel, and an unpredictable low water season.

These hardships were bearable before the railroads brought competition, but by 1866 improvement was needed. The boat builders had performed wonders in adapting their boats to the Mississippi. But the design had been carried to near-perfection. Further improvements would have to lie with the Mississippi itself.

At this point and for this reason, the Corps of Engineers arrived to begin a series of projects to improve navigation on the Upper Mississippi River.

Notes

Chapter 1

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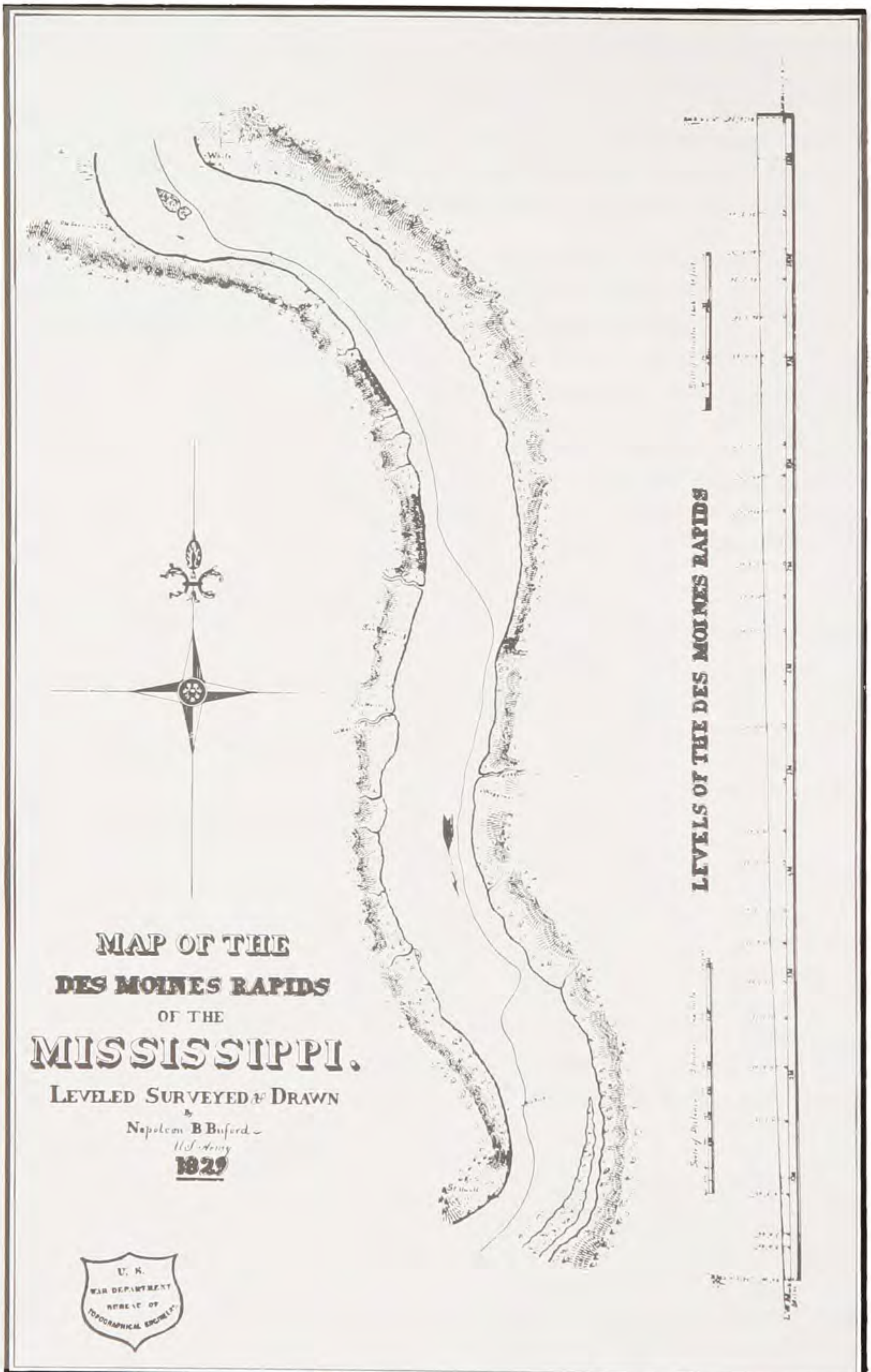
10. Some sources put this date on May 25.

11. Beltrami, p. 159.

12. Hartsough, p. 84.

13. *Ibid.,* p. 99.

14. *Ibid.,* p. 116.


MAP OF THE
DES MOINES RAPIDS
OF THE
MISSISSIPPI.
LEVELED SURVEYED & DRAWN
By
Napoleon B Buford -
U.S. Army
1829
LEVELS OF THE DES MOINES RAPIDS
U. S.
WAR DEPARTMENT
BUREAU OF
TOPOGRAPHICAL ENGINEERS

Chapter 2

The Engineers Go to School on the Mississippi

From George Washington's Continental Army to the construction and operation of locks and dams serving modern commercial barge and towboat traffic on the Upper Mississippi may seem to be a long stretch in time and space for any organization, but that is one of the many directions the United States Army Corps of Engineers has taken in its 200-year history.

On June 16, 1775, the day before the Battle of Bunker Hill, the Continental Congress appointed a Chief Engineer and three assistants to aid in designing sieges and fortifications.[1] This unit was abolished in 1783 when the war with England was over, and it was not until March 16, 1802, that the Jefferson administration created a permanent Corps of Engineers. Sixteen officers and four cadets were directed to take station on West Point, New York, which was constituted as a military academy.[2]

The first Engineer map of the Des Moines Rapids, drawn by Lieutenant Napoleon Buford to accompany his 1829 survey report. Though accurate, the map lacks much detail because Buford made his survey in February while the river was covered by a foot of ice and nine inches of snow.

In 1816 a half-dozen officers were added as topographical engineers, though they were not strictly limited to surveying and mapping. These

topographical engineers began the first surveys of the interior of the United States. One of these new engineers was Lieutenant Stephen H. Long, who was assigned to the Southern Division under General Andrew Jackson, and who was to take part in many of the early explorations of the Upper Mississippi Valley.

The expansion of the Corps of Engineers from fortifications to civil works was both natural, and, in a young country with vast public lands but limited industrial resources, necessary. By training on civil projects during peacetime, Engineers could prepare themselves and keep ready for wartime needs. At the same time, civil engineers were in extremely short supply during the first part of the 19th century. For a long time, West Point was the only school in the country which taught engineering. It remained the leading engineering school in the country until the Civil War. If the West were to be settled, it had to be reached. The only engineers available to do the job of building the roads and canals, charting routes for the growing railroad industry, and improving navigation on the inland waterways were those West Point graduates.

This early emphasis on transportation helped to formulate the long-lasting Corps policy of single-purpose improvement projects on the Mississippi. Not until the Mississippi River Commission was established in 1879 did projects for other than navigation purposes begin.

Congress early in its history got the Federal Government into the business of public works. The first session in 1789 passed an act providing that "a lighthouse shall be erected near the entrance of Chesapeake Bay."[3] In 1802 President Jefferson ordered $34,000 to be spent for public piers on the Delaware River.

In addition, most of the Colonies came into the new Republic with surplus land. Maryland refused to sign the Articles of Confederation until there was evidence that the new government would have control of these unsettled lands. In 1780 New York set

a precedent by ceding her claims to the United States. Others followed, and by 1802 Georgia, the last state, ceded her lands to the Government. With the Louisiana Purchase the following year most of the present United States passed into the public domain.

However, even Presidents such as Thomas Jefferson, Andrew Jackson, and Martin Van Buren, who saw the need for internal improvements, had doubts about the constitutionality of federal assistance in such projects. Jefferson suspected, and his successor James Madison was confident, that an amendment would be needed to permit the Federal Government to enter the field of public works. The expeditions of Lewis and Clark, and the later explorations of Lieutenant Zebulon Pike, Major Stephen H. Long, and Lieutenant John C. Fremont did serve primarily civil purposes, including taking stock of our national resources and identifying and classifying new plants and animals; but all of this had to be done under the guise of national defense. Until well into the 19th century, "military preparedness" was nearly always one of the reasons given for navigation improvements on the inland waterway. Even then, several Presidents, most notably Polk and Pierce, were opposed to Federal public works projects and succeeded in cutting appropriations to a minimum.

But the need for such improvements remained, and in 1818 the House of Representatives considered what improvements could be made as national defense measures. President Monroe's Secretary of War, John C. Calhoun, was instructed to write such a report. Calhoun went far beyond the official request and produced a carefully thought-out and detailed scheme for building roads and canals and for improving river navigation.

Calhoun's report played a major part in determining the role of the Corps of Engineers in civil works for his entire plan was based on the premise that the surveying, planning, and supervision of construction of these projects would be wholly in the hands of the Army Engineers. Calhoun's report also

smoothed the way for projects which, while having military value, were also of obvious commercial value as well.

Caught between increasing need for improvements and recurring questions of constitutionality, Federal navigation projects on the Mississippi and Ohio proceeded fitfully and piece-meal. The problem of constitutionality was not settled until 1866, after the Civil War. Only then did the improvement of the Upper Mississippi begin in earnest.

Nevertheless, within the limits of small and random appropriations, Engineers had performed a number of surveys and experimental improvement projects between St. Paul and St. Louis by the time Colonel Wilson arrived in 1866.

Much of this early surveying and experimenting was performed by the Topographical Bureau.[4] As has been mentioned, topographical engineers had originally been appointed in 1816 as part of the regular Engineer Corps. On July 2, 1818, a separate bureau was created, but still within the Corps of Engineers. As a result of the increasing number of civil improvement projects, the Topographical Engineers were removed from the Corps of Engineers on July 5, 1838, and formed into a separate and equal Corps of Topographical Engineers under Colonel J.J. Abert.

On August 1, 1838, Secretary of War Poinsett transferred all civil works directed by the United States to this new corps, reserving the Army Corps of Engineers for fortifications and other military construction. Although this dividing line was not strictly observed, most of the improvements on the Upper Mississippi between 1840 and 1860 were supervised by Topographical Engineers. Major G.K. Warren's early work on the Mississippi was as an officer in this Corps.

In 1863 the two Corps were again united as a single Corps of Engineers under Major General Andrew A. Humphreys. The Corps of Topographical

Engineers had only two Chief Engineers from 1838 to 1863: Colonel Abert and Major Stephen H. Long.

Long was the first Engineer to explore the Upper Mississippi. Between 1816 and 1818 he made surveys of the Illinois, Fox, Wisconsin and Minnesota Rivers.[5] On July 9, 1817, with a party of 15, he set out from Prairie du Chien, Wisconsin, in a six-oared skiff to examine defense sites along the river valley. He reached the Falls of St. Anthony, then returned downriver to St. Louis. He stayed a few days at Fort Armstrong, which he considered an ideal fort, and then became the first of a series of Engineers to lose a contest with the Des Moines Rapids when his boat, much battered by the rocks, sprang a leak as he neared Fort Edwards.[6]

The first direct effect of the Calhoun report came in 1820 when Congress appropriated $5,000 for the first Corps of Engineers survey, an examination of the Ohio and Mississippi Rivers from Louisville to New Orleans to "determine the most practical means of improving their navigation." The report of this survey, made by Brigadier General Simon Bernard and Major Joseph G. Totten suggested "clearing and snagging" as the primary means of improvement.

In 1822 Congress passed the first appropriation for river and harbor work, a sum of $22,500. There was no appropriation in 1823, but in 1824 Congress appropriated $115,000 for improvement work, the first of what were to become regular annual appropriations for "rivers and harbors." In 1824 Congress also passed the General Survey Act "to procure the necessary surveys, plans, and estimates, upon the subject of roads and canals."[7] The General Survey Act was the most important direct result of the Calhoun report. It gave the President authority to employ officers of the Corps of Engineers to make surveys "as he [the President] may deem of national importance."[8]

To administer this Act, President Monroe appointed a Board of Engineers for Internal Improvements, consisting of Chief Engineer Alexander Macomb, his assistant, Bernard, and John L.

Sullivan, a civil engineer. Topographical Engineers from the Topographical Bureau were attached to the Board, and a vigorous campaign to survey projects got under way.

Prior to 1829, however, few of these appropriations reached the Upper Mississippi. The Ohio and Lower Mississippi Rivers were more settled and more closely connected to the markets of the East. Although there was some trade as far north as St. Louis, steamboats were still in the process of developing enough power to brave the swifter currents above St. Louis. The Upper Mississippi was still dominated by keelboats and flatboats. The snagboat which Henry Shreve was asked to develop in 1829 was only for the Lower Mississippi.

Appearances on the Upper Mississippi by Corps officers during the 1820's was incidental to other purposes. Long had taken the *Western Engineer* up to Keokuk in 1820 just for show. In the spring of 1823 he again passed along the Upper Mississippi on an expedition to discover the source of St. Peter's River (later named the Minnesota River). Long and his party came by way of Chicago, "a few miserable huts inhabited by a miserable race of men."[9] From Chicago, they cut across the wilderness to Fort Crawford at the mouth of the Wisconsin River and then went by land up the right bank of the Mississippi into Minnesota. On this trip Long saw the advantages of a waterway connecting the Great Lakes with the Mississippi, and became the first Engineer to suggest a canal connecting the two between Lake Michigan and the Illinois River.

Not until 1829 did the effect of the General Survey Act of 1824 reach the Upper Mississippi. Late in 1828, Chief Engineer Brigadier General Charles Gratiot ordered Lieutenant Napoleon B. Buford, 3rd Artillery, on Topographical Duty, to "make reconnaissance and survey of the Des Moines and Rock River rapids, with a view to overcoming the obstacles to the navigation of the river at those points."[10]

Using the assistance of soldiers from Fort Arm-

strong, Buford began his survey at the Des Moines Rapids on February 13, 1829, making both a topographical map and a profile of water levels at the surface. Lieutenant Buford's map was too general to be of much use to later engineer surveys, but it was amazingly accurate considering the fact that when the lieutenant made his survey, the Mississippi was covered with one foot of ice and nine inches of snow.

In his report, Buford noted that with the exception of 11¼ miles at the Des Moines Rapids and 13¾ miles at the Rock River Rapids (changed to the Rock Island Rapids after 1860), the whole of the river from St. Louis to the Falls of St. Anthony was navigable for eight months of the year by boats of 4½-foot draft. Because of the rapids, however, navigation was reduced to the four months of high water each year.

Buford's report examined two alternative methods of improving the channel at Keokuk and Rock Island: constructing lateral canals around the rapids and excavating the existing channel to a depth of five feet. He concluded that the problems involved in lateral canals, especially around the Des Moines Rapids, were "almost insurmountable,"[11] and recommended using coffer dams to expose the rock in shallow places and blasting it loose. His estimates of the ease with which the improvement of these rapids could be achieved proved to be overly optimistic (a common problem for the next 40 years).

Supporting his recommendations for improvement, Buford pointed out both military and commercial advantages. Foremost among these advantages was assistance to the Galena lead traffic (which of course could be considered a military need). By 1829 the lead mines at Galena were employing 10,000 workers. The Port of Galena, then reachable by boat, was by far the busiest steamboat landing north of St. Louis.

Although Buford's report was published as a House Document, Congress took no action. For the

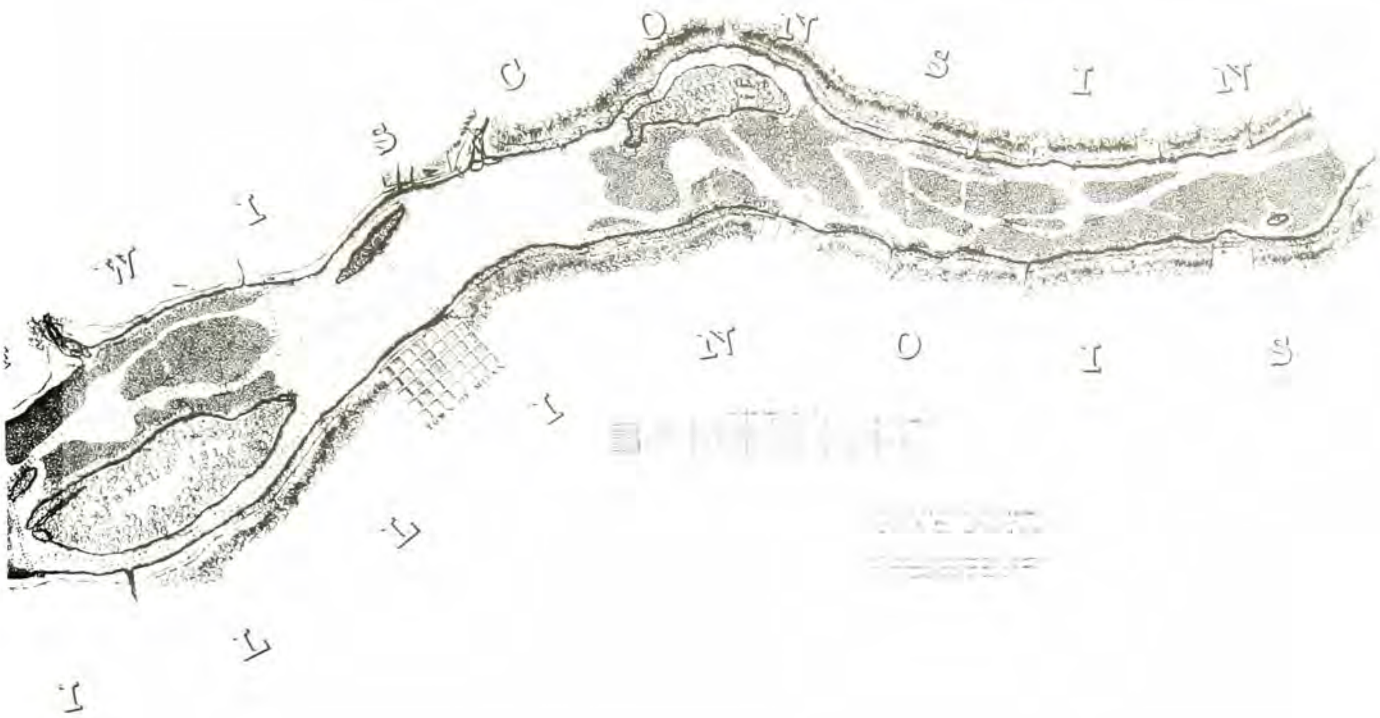
Lieutenant Robert E. Lee's map of the Rock Island Rapids, made in 1837 during the first of three seasons Lee spent on the Upper Mississippi. Lee recommended improving these rapids by cutting off the rock projections which made the natural channel twisting and dangerous.

next seven years there was no Corps of Engineer activity on the Upper Mississippi.

The end of official responsibilities did not end Buford's presence on the river, however. As was the case with other Engineers who came to work on navigation improvements, he fell in love with the area. In 1833 his parents and family moved from Kentucky to Rock Island, where his father opened the first store on Main Street of the young town. The Buford family built an imposing mansion in Rock Island (later used as the Tri-Cities Jewish Center), and over the years provided their share of well-known river pilots.

Lieutenant Robert E. Lee and the Rapids

Corps of Engineer activities resumed on the Upper Mississippi in 1835 when the river began cutting a new channel close to the Illinois shore opposite St. Louis. Bars had formed above and below



the St. Louis waterfront and were threatening to cut off river traffic. In 1836 Congress appropriated $15,000 to build a pier above St. Louis to deflect the current back toward the Missouri shore and scour out the old channel. Chief of Engineers Gratiot asked Henry Shreve to draft a plan for the pier. At the same time, he requested Shreve to make recommendations for improving the Des Moines and Rock River rapids.

In the summer of 1836 Shreve went north in a small Government steamboat to look at the rapids. He was not familiar enough with either rapids to make recommendations without study. He visited the Rock River Rapids first, threading the mazes of those rapids until he knew them well. Then he charted a channel through the middle of them, and planned which edges to cut off.[12] He noted that marking such a channel with buoys would be difficult, especially because ice each winter would carry them away. Instead, Shreve's recommendation was "to establish Pilots authorized by law to be located at the Rapids with fixed Salaries,"[13] who knew the

rapids and could guide boats through the narrow and twisting channel. This is exactly what happened at the Rock Island Rapids with the arrival of regular steamboat traffic, though as a brisk private business rather than as a Government service.

A different set of problems confronted Shreve at the Des Moines Rapids. Here the rapids consisted of a single rather uniform layer of rock which made the whole stretch shallow and without the characteristic ripples to indicate obstructions. Shreve concluded that a channel cut through these rapids would be useless at night, and even during the day would require buoys and rapids pilots who knew where the improved channel was. Instead, Shreve recommended excavating a channel 90 feet wide along the Iowa shore. In this way the improvement would not interfere with present navigation while it was being built and more important, the shore line would form one side of the channel and serve as a guide for the pilots.[14]

Shreve returned to St. Louis and finished plans for the St. Louis pier, but too late to begin work during the 1836 season. He might have been assigned to complete these projects had not a young Engineer officer on duty with the Chief Engineer's Office in Washington volunteered for the St. Louis post. Lieutenant Robert E. Lee found official Washington dull and was looking for something more challenging. General Gratiot had taken a liking to Lee and gave him the post he had requested. As an assistant to Lieutenant Lee, General Gratiot assigned Second Lieutenant Montgomery Meigs, a young West Point graduate of 21. Meigs later supervised the construction of several important Corps projects, including the Capitol dome, the Washington Aqueduct and the Pension Building in Washington, D.C., and was Union Quartermaster-General during the Civil War.

Lieutenants Lee and Meigs set out for St. Louis in August 1837. Gratiot had already been there to make a personal inspection of the work to be done. He was a native of Missouri and had long been interested in the improvement of the Mississippi

River. In giving this post to a young, untried Engineer, he showed great faith in Lee's potential.[15]

Lee was not impressed with St. Louis at first. "It is the dearest and dirtiest place I was ever in," he wrote to his close friend Andrew Talcott, "Our daily expenses about equal our daily pay."[16] But he grew to like the place during his three seasons there, and the citizens of St. Louis grew to like him. In 1838 when Congress cut off appropriations for completing the St. Louis pier, Lee found himself in the middle of a fight between St. Louis political factions, each side blaming the other for the Congressional action. True to Corps tradition, Lee refused to take sides. The Missouri *Republican* of October 1838 wrote of him:

> The character of the Superintendent forbids the idea that he would make such a declaration for electioneering purposes; in fact, we believe he has deported himself throughout our election as every government officer should, but as very few at this day do, taking no part in the contest.[17]

During the 1838 and 1839 working seasons, Lee brought his growing family along to his St. Louis post.

The Act of March 3, 1837, appropriated an additional $35,000 for work on the St. Louis pier. The same act appropriated $40,000 for continued improvement of the Mississippi River above the mouth of the Ohio and of the Missouri Rivers. With these funds Lee was directed to resurvey the Des Moines and Rock River Rapids, to determine a plan for their improvement, and to begin such improvement as funds would allow.

Almost immediately on arrival in St. Louis in 1837, Lee and Meigs made plans to survey the two rapids. Earlier, in Louisville, Henry Shreve had turned over to them all the boats and equipment he had assembled for the project. Using these and a hired crew Lee and Meigs proceeded upriver. The captain of their small steamer was Henry Shreve's son-in-law, Captain Morehead.

Lee's original intention had been to begin the survey at the Rock River Rapids, but as the party

reached the lower rapids at Keokuk their boat furnished concrete proof of the need for channel improvement by running aground on the rocks. Since the boat was impossible to move at the existing water stage, Lee decided to begin the survey at Keokuk. Lee and Meigs used the grounded boat as headquarters for the first three or four miles of the survey. After this they camped along the Iowa shore as they moved up the rapids.

Lee's letters during this period capture the flavor of frontier life. In a letter to Andrew Talcott, Lee related that at one encampment, having filled a vacant cabin with his men,

> Meigs and myself took up our blankets and walked a short mile to the City of Des Moines composed of the worst kind of a small log cabin which contained the Proprietor and the entire population. Here we were kindly received and all accommodated with the softest Puncheon on the floor. How much I would tell you of the same city, its puncheons, dwellings and inhabitants, but I must look to my limits.[18]

Leaving the steamboat crew behind, Lee and his crew moved to the upper rapids where they found a greater degree of comfort and civilization at Davenport and the brand new town of Stephenson (later Rock Island). For accommodations Lee moved his party onto a steamboat that had been wrecked and abandoned on the rapids. The bottom had been torn out, but the two upper decks were above water. Here Lee and his men lived well, fishing for blue catfish over the side of the boat in the evenings.[19] "I assure you," he wrote to Talcott, "we were not modest, but fell without difficulty into the manners of the country, and helped ourself to everything that came our way."[20]

By the time Lee returned to Keokuk high water had floated his boat free and he returned to St. Louis by October 11 to draw up maps of the rapids and write reports of his surveys. He also drew up plans for improving the St. Louis waterfront, generally using Shreve's recommendations, but by the time they were finished the season was too advanced to begin work, and Lee requested permission to return to Washington and his family for the

winter. Before leaving he made preparations for the following spring by contracting to have a steamboat and four flatboats built.

His report on the two rapids was somewhat more detailed than Buford's, but Lee was equally mistaken in imagining the ease with which the improvements could be made. Lee's conclusions were consistent with Buford's, that improvement of the main channel at Keokuk and Rock Island was the best solution. He rejected Shreve's suggestion of a lateral canal at the Des Moines Rapids because it would involve an excavation of stone three times as great as would be needed to improve the natural channel to a width of 200 feet and a depth of 5 feet. Lee felt that cutting a channel through the Rock River Rapids would be even easier. The rapids were not consistently shallow. The difficulty was the natural channel's tendency to twist and turn its way through the chains of rock jutting out from the shores. These rapids Lee proposed to improve by cutting off some of the projecting points of rock at short turns and narrow places, and by placing buoys to guide boats through the crooked channel.

Lee estimated that to complete the entire project would require $189,622 at the Des Moines Rapids and $154,658 at Rock Island, an estimate that turned out to be short by almost $5,000,000. In concluding his report Lee pointed out the necessity of the rapids improvement which would open up a whole country above the rapids that was "daily increasing by a constant stream of emigration."[21] Twenty boats of over 150 tons each were already in regular service on the Upper Mississippi.

In planning and carrying out improvement of the rapids and the St. Louis pier, Lee was doing pioneer work on the Mississippi. Prior to this, Federal activities on the river had been limited to cutting and removing trees along the shores and removing snags from the channel.

When Lee returned to St. Louis the following May to begin the actual work of improvement, he had been promoted to Captain. He remained in St. Louis to superintend the channel project there and sent

his new assistant, Horace Bliss, to the Des Moines Rapids to take charge of that improvement.

Bliss soon experienced an aspect of the Mississippi that would plague every Engineer involved in river improvement through the 19th century. The seasons of high and low water were extremely variable, forcing men to work when the river wanted them to work rather than when they were prepared to do so. The high water Bliss found when he arrived in Keokuk in the middle of May should have dropped, but Bliss and his crew were kept idle for weeks while the river continued to rise.

Just as Lee had given up hope for the season, the river fell unexpectedly. Lee and Bliss assembled a small crew and returned to the Des Moines Rapids, where they began cutting rock out of the Illinois Chute. Work was no sooner under way than cold weather hit on October 10. Lee kept on the hardiest of his men, more than doubling their wages, but on the night of October 16 the river froze, followed by snow the next day. Lee was forced to abandon work on the rapids without really having had a chance to prove his plan. The small amount of work done in the fall of 1838 did not improve the channel much, but it did convince Lee that a channel could be cut.

The Act of July 7, 1838, appropriated \$20,000 for the Missouri River and for the Mississippi above the mouth of the Ohio, and \$1,000 each for surveys of the Rock River with a canal to Lake Michigan, and for a survey of the Des Moines and Iowa Rivers. But the whole \$20,000 was diverted to Shreve's snagging operations, and the tight money situation resulting from the "specie circular" scandal and the Panic of 1837 made further Congressional appropriations impossible. During the 1839 season Lee used what money was left from previous appropriations to finish the St. Louis project, limiting his work on the rapids to the Lower and English chains of the Des Moines Rapids. With Horace Bliss in charge again this season, work went ahead better than the previous year. Lee came to Keokuk about the middle of July to supervise the work, taking time out to make a trip to Galena where he happen-

ed on several old West Point friends and enjoyed soda water and ice cream "four times a day."[22]

Subsequent Engineers who came to work on the Des Moines Rapids generally regarded Lee's work as experimental and tentative without having much effect, but by the end of the 1839 season, when the work concluded, Bliss had removed nearly a whole reef at the Lower Chain and had opened a passage 50 feet wide and 4 feet deep through about four miles of the worst section of rapids. He had excavated some 2,000 tons of rock.

Lee had also experimented with buoys on this channel, placing four of iron and four of wood, bolted to the rock bottom, but the ice, as expected, pulled them all out.[23]

In his report of 1839, Lee recommended that the previous practice of working season after season with small appropriations and few pieces of equipment be abandoned in favor of using many boats and a large crew working along the entire rapids at the same time. The short and uncertain seasons on the Upper Mississippi and the expense of maintaining and repairing boats over the winter made the year-after-year approach more expensive in the long run.[24]

Neither method was approved, however, as the depression continued into 1840 and appropriations were not renewed. After August 27, 1839, Chief Engineer Brigadier General Joseph G. Totten, General Gratiot's successor, sent Lee on various surveys and inspections on the Ohio, Mississippi, and Missouri Rivers. At the end of the 1839 season, Lee left behind at Keokuk one steam towboat, three keelboats fitted for quarters, a smith's shop, a laboratory, five transportation boats, two double crane boats, one single crane boat, one current boat for towing, and enough platforms, drills, and stands for one hundred men.[25]

The method developed by Lee and Bliss for blasting rock under water was used with several improvements and variations throughout most of the

rest of the rapids improvement work. This method consisted of placing iron tripods over the rock to be blasted. On the tripod was placed a platform for workmen. It also served as a guide for the drills. Workmen then drilled a 1¾-inch diameter hole down through ⅔ of a single rock layer. (Lee found it impractical to remove more than one stratum at a time.) A charge of one-half pound of powder was placed in a tin tube, and the remainder of the tube filled with sand. The tube was prepared and placed in the hole immediately on removing the drill. It rose above the water and was supported by the tripod. The effect of such an explosion was merely to split the rock so that it could be removed in large pieces. Using this method, underwater blasting could be done almost as economically as on shore.[26]

Congress again failed to vote further appropriations in the spring of 1840, and when Lee returned to St. Louis at the end of July, it was only to survey the previous work and advise his assistant, Henry Kayser, who had been hired by the City of St. Louis to complete the waterfront project. No further work was done on the two rapids.

Henry Kayser stuck to Lee's plan of improvement and eventually the bar that had been forming in front of St. Louis washed away. The channel along the Illinois shore that Lee had closed off filled in and later became East St. Louis, Illinois.

One interesting sidelight of Lee's years on the Upper Mississippi is a persistent story among local history buffs that the young Lieutenant was so impressed with the country along the river that he invested in, and laid out, a town site along the shore near the present city of Davenport, Iowa. One basis for this rumor can be found in *The History of Davenport and Scott County, Iowa*, by Harry Downer (Chicago: S.J. Clarke, 1910). Downer reprints an excerpt from a journal of an early Rock Island resident, Suel Foster, who recalled taking a trip down the Iowa (then Michigan Territory) side of the Mississippi in 1836. Foster went from Davenport to Muscatine and reported seeing stakes laid out for future towns along nearly the entire 50 miles. Six miles downriver from Davenport, he

reports coming across the town of Iowa "laid out by Captain Robert E. Lee and William Gordon (the same Lee afterwards the great Rebel general)." Suel Foster also noted that Captain Lee had appointed himself mayor of that future town, though he was absent when Foster arrived, busy "surveying the route of the great river."

No confirming evidence can be found for this account, and the 1836 date which Foster gives for his trip is two years before Lee spent any time in the area; but it remains just possible that Captain Lee's work on the Upper Mississippi did add to his honors a previously unreported title: "Mayor" Lee.

Scattered Surveys, Examinations and Experiments

During the next 15 years from 1840 to 1855 only minor surveys and improvements were carried out on the Upper Mississippi. A survey of the Rock River and the Rock River Haven (a chain of four lakes in and near the present city of Madison, Wisconsin), authorized in 1838, was completed by Captain T.J. Cram of the Topographical Engineers. This was a preliminary investigation for a project to connect the Rock River by canal to Lake Michigan, with the chain of lakes serving as feeders for the canal. Cram outlined the rapids and bars that would have to be removed in order to make the Rock River navigable.[27]

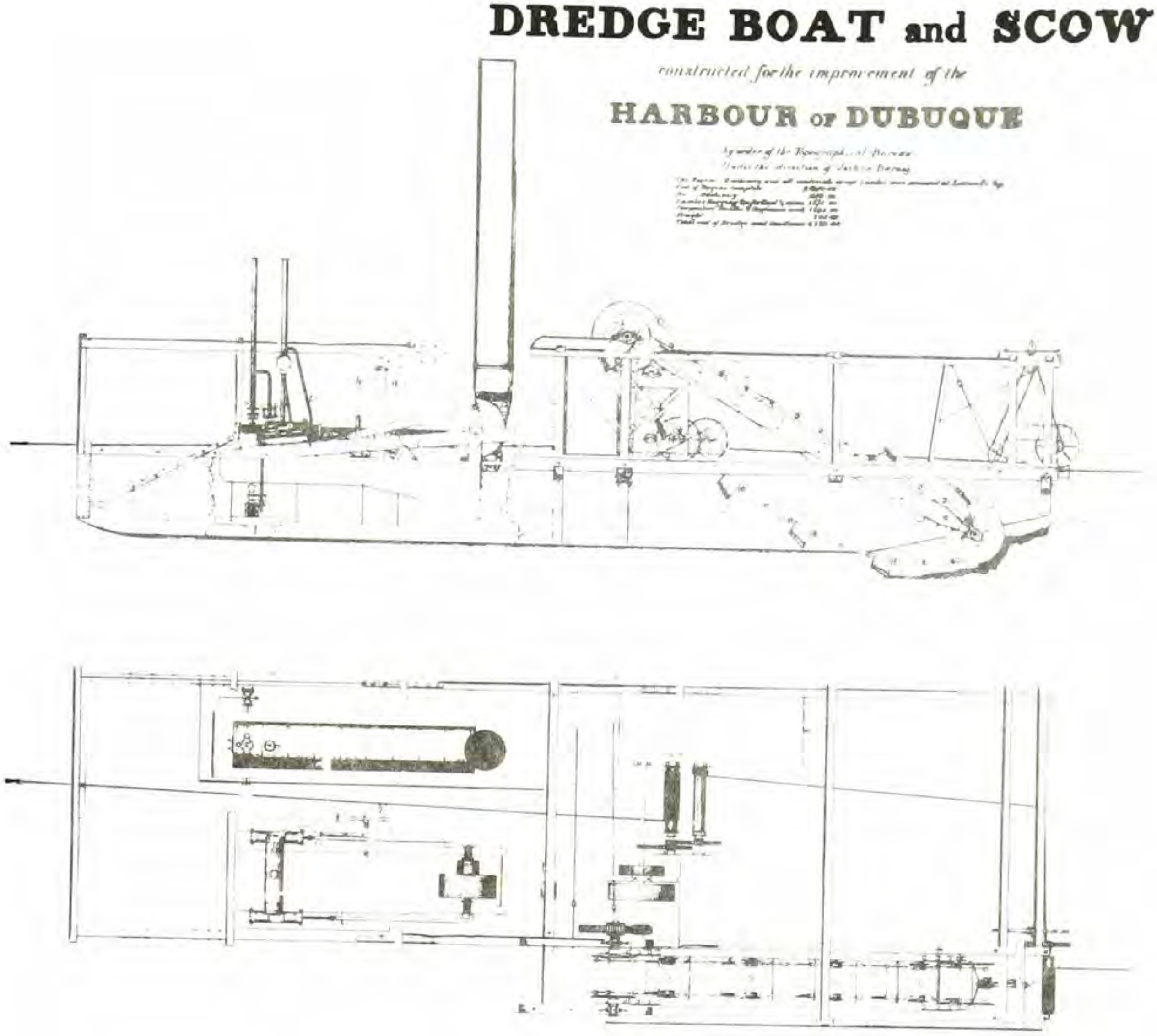
Perhaps the only survey on the Upper Mississippi that resulted from a romance was made in 1841. John C. Fremont, a young Lieutenant with the Topographical Engineers in Washington, got to meet Senator Thomas Hart Benton from Missouri. Benton's expansionist ideas fired Lieutenant Fremont's zeal. Fremont had already spent some time on the Upper Mississippi in 1836-37, when he had assisted the distinguished French scholar, J.N. Nicollet with explorations for the source of the Mississippi.

In the course of events, Fremont fell in love with Jessie Benton, the Senator's daughter. In order to

separate the couple, Senator Benton arranged to have Fremont assigned to the survey of the Des Moines River which had been authorized in 1838. Fremont carried out a survey of 203 miles of the Des Moines River from its mouth to Raccoon Fork in July 1841. Fremont made a map of the river (never published though a copy exists in the National Archives), but he seems to have paid more attention to the flowers and wildlife along the way. His report contains extensive descriptions of flowers, plants, and geographical features.[28] Fremont then returned to Washington, where he married Jessie Benton.

In 1843 the Corps of Topographical Engineers adopted a divisional structure which placed Major Stephen H. Long at Louisville, Kentucky, as Superintendent of Improvements on the Mississippi, Missouri, and Arkansas Rivers, and on the Ohio below the falls at Louisville. Long reviewed the previous reports and surveys of the work in his charge and wrote a detailed report of the status of the projects for his superiors. He agreed with Lee's recommendation for excavating the natural channel at both the Des Moines and Rock Island Rapids. To solve the problem of pilots being able to find such an improved channel, Long suggested not buoys but "longitudinal strings or ribbands of large and heavy timbers, in continuous lines strongly spliced and bolted to the rocks at the side of the channel, and thus forming a guard to prevent the boats from impinging against the rocks."[29]

Under Long's direction the first harbor improvement work on the Upper Mississippi was begun. In 1844 Congress appropriated $7,500 for deepening the harbor at Dubuque, Iowa, to accommodate steamers of the largest class. A small amount of dredging was done in 1844 by Joshua Barney, United States Agent,[30] who had worked with Long in 1827 as a young Lieutenant, but the work was not completed with the amount appropriated, and no further funds were authorized until 1853. The Mexican War in 1846-47 stopped all appropriations and drew many of the Topographical Engineers away from civil works.



Plans for a ladder dredge *Devasseur,* designed by United States Agent Joshua Barney in 1844, under the direction of Major Stephen H. Long, for improvement of the harbor at Dubuque, Iowa.
—National Archives

Part of the $7,500 appropriated for Dubuque harbor may have been used to build a dredge boat, the *Devasseur.* Plans for the boat exist in the National Archives (see illustration) and indicate that the boat was built, but other scattered records from the period do not confirm this. The *Devasseur,* as the illustration shows, was a "ladder dredge" using scoops on a continuous belt to make shallow cuts in mud, sand, and gravel. It was self-propelled by a steam winch attached to lines on opposite shores. The dredge pulled itself along these lines, cutting a narrow channel as it went. If this boat was actually built, it was the first piece of floating plant con-

structed by the Corps specifically for an Upper Mississippi River project.

In 1850 Congress appropriated funds for the famous Mississippi Delta Survey. Under the supervision of Captain Andrew A. Humphreys and Lieutenant Henry L. Abbot, the Corps of Engineers began the first truly scientific survey and examination of nearly the entire Mississippi River Valley. When Humphreys' report was finally filed and published in 1861 as the *Report Upon the Physics and Hydraulics of the Mississippi River,* it immediately became a standard resource and a model of imitation for succeeding reports. Work on this report gave Humphreys a close look at the Des Moines and Rock Island Rapids, and his advice became valuable to Colonel Wilson when he began improving those rapids in 1866.

Renewed interest in the improvement of navigation on the Upper Mississippi resulted in the passage of the Western Rivers Improvement Act in 1852. This Act placed river and harbor work more firmly under the direction of the Corps of Engineers. Congress appropriated $90,000 for improving navigation below the Des Moines Rapids, $100,000 for work on the Des Moines and Rock Island Rapids, $15,000 to complete dredging of the Dubuque harbor, and $30,000 for improvement of the Illinois River. The last item was a Federal response to the Illinois and Michigan Canal which ran between Lake Michigan at Chicago to the Illinois River at LaSalle, and which had been completed by the State of Illinois in 1848.

The Western Rivers Improvement Act also brought Long new responsibilities, the Superintendency of Western Rivers. Long hired his brother, George Washington Long, to examine the Illinois River. George Long found 33 bars and shoal places at low water. By 1854 Major Long had sent the Corps dredge #2, the *Gopher,* up the Illinois to work at clearing a channel.

The improvement of Dubuque harbor, begun in 1844, was resumed on July 1, 1853, again under

local charge of Captain Barney. Captain Barney was also in charge of constructing a new dredge for the work, and was responsible for improvements at the Rock Island Rapids. Also on July 1, Long placed Captain John Floyd in charge of the Des Moines Rapids.

Barney went to Louisville, Kentucky (still Long's headquarters), during the spring of 1853 to supervise construction of the new dredge. This dredge, built at a cost of just over $20,000, was a ladder dredge similar to the *Devasseur* built in 1844. It had a draft of 3½ feet, and was very difficult to operate properly. Rising and falling water posed problems, as did the many submerged stumps in the harbor. The dredge propelled itself by anchoring lines fore and aft, and winching itself ahead as it made a narrow cut in the channel. A 500-pound anchor was needed to haul the boat ahead. In addition, the dredge needed lines anchored from each side to keep it from slipping back into the adjacent cut as it made slice after slice to obtain the desired channel width. The two 76-foot by 15-foot belts which ran the ladder of buckets slipped so badly when the buckets hit hard mud that they frequently caught fire and had to be replaced.

Dredge Boat #1, as it was called when it arrived at Dubuque in 1853, was renamed the *George W. Jones* in honor of a United States Senator from Dubuque. The purpose of dredging the Dubuque harbor in 1844 had been to open a channel from Dubuque to the main Mississippi channel near the Illinois side, but by 1853 something new had been added. The 1853 project, reported Major Long, "obviously has for its object the opening of a navigable channel leading from the main business landing of Dubuque, directly across the Mississippi to the contemplated terminus of the westerly branch of the Illinois Central Railroad."[31] Railroads were approaching the Mississippi not only here but at Rock Island as well, and they were planned at several other places. More and more, these railroads would complicate the work of the Engineers on the Mississippi.

By 1854 the Dubuque harbor was in worse condition than it was before the work began. The new cut had not been completed, while dredged material from this new cut had been placed in the old former channel, making it even shallower. Further, business interests in Dubuque had begun construction of a causeway out into the river above Dubuque, using material dredged from Barney's project. All of this interfered with river traffic and the end result was that Long received a reprimand from Secretary of War Jefferson Davis over the Dubuque project. Long went to Dubuque to supervise the work personally but without success. Ice on the river made the immediate removal of the dredged material impossible.

Work on the project was suspended, and in May of 1855, the *George W. Jones* was ordered to assist in dredging on the Illinois River. The boat had difficulty getting over the Rock Island Rapids, considerably injuring its bottom, and it was permanently stopped by low water at the Des Moines Rapids.

Barney's responsibilities at the Rock Island Rapids consisted of contracting for improvement work. He advertised in both local and Eastern papers for the work to begin in early October of 1853, but no acceptable offers were received. Similar difficulties continued to be a problem on the Upper Mississippi. Much of the work was of such an experimental nature that few contractors had equipment to do the work or the knowledge necessary to make reasonable bids. And no contractor was eager to invest in expensive, specialized equipment considering the past history of Congressional appropriations.

Also in 1853, Major Long detailed another of his assistants, Lieutenant Gouverneur K. Warren, to make a third survey of the Des Moines and Rock Island Rapids. This was the first of many services Warren performed for the Corps of Engineers on the Upper Mississippi. Warren had gotten his field training three years earlier when, as a young 21-year-old West Point graduate, he had been

assigned to the Mississippi Delta Survey under Humphreys and Abbot.

Warren's orders were to examine both rapids "to determine the most direct favorable and economical passes or routes along the bed of the river for the formation of a continuous navigable channel at least two hundred feet wide and four feet deep at the lowest stage of the river ever known or likely to occur again."[32] He was to mark the sections of rapids into mile lengths, note how much improvement was needed in each, and what kind, find a place to put the spoils, and then mark the proposed channel with buoys and landmarks.[33]

Warren began his survey work at the Rock Island Rapids on June 26 and worked there until September 21 when he left for Keokuk. His survey of the Des Moines Rapids took until December 1, when he left for St. Louis to write up his reports. His surveys took this long partly because of high water and partly because of a lack of cooperation from Captain Barney and Major Floyd, who were supposed to assist him, but it was also because of the careful and deliberate manner in which Warren worked. The Warren Report published in 1854 was far more detailed and useful than the earlier reports by Lee and Buford.

One of Warren's first suggestions to Long was to change the names of the two rapids in Corps correspondence to the "upper" and "lower" rapids. These were the names by which they were known in the area and used by steamboatmen; in addition, said Warren, it would avoid confusion with rapids in the Des Moines and Rock Rivers. Although this change was not adopted, the name of the Rock River Rapids did change shortly to the Rock Island Rapids.[32]

Because of continued support among rivermen for Shreve's recommendation of a lateral canal around the Des Moines Rapids, Lieutenant Warren made a particularly close examination of the existing shore channel along the Iowa side of the river. That channel had only 10 to 12 inches of water in places and was used wholly by "lighters," small, horse-drawn

flatboats 100 feet long by 20 feet wide, which could carry from 100 to 200 tons of goods. Lighters were needed at the rapids to relieve the large packetboats of their cargo so that the steamers could pass the rapids at low water. During the low-water season, boats with drafts larger than 24 inches could not get over the rapids. Warren reported that the lighters needed "luck and eight horses" to make the trip from Keokuk to Montrose at the head of the rapids in six hours.[35]

Lighters were expensive as well as slow. In 1853 it cost $1 per ton to lighter goods down the rapids and $1.25 to lighter them up. In addition, Warren reported, the money lost by waiting steamboats was even greater because "salaries are paid as high as 35¢ per hour."[36] The rapids drove other wages up as well. Warren found that he was unable to hire rowers for his survey, even at $1.25 per day, because "the great quantities of freight at both ends of the Rapids gives employment to every industrious man at high wages."[37]

Travel on the Rock Island Rapids was not much faster. On one occasion while he was surveying these rapids, Lieutenant Warren and his crew were forced by the current to tow their rowboat along the shore from Davenport fifteen miles up to the head of the rapids at Le Claire. They arrived three hours ahead of a steamboat that had left Davenport at the same time.[38]

As directed, Warren also experimented with buoys at the Rock Island Rapids. He used white cedar logs eight inches in diameter and three and one-half feet long, but he could only get them to show adequately where the current was slack.

In his report on the Des Moines Rapids, Warren anticipated that such a lateral canal as suggested by Shreve might eventually become the permanent method of improving the Des Moines Rapids, but recommended that the present work be limited to deepening the natural channel. Such an improvement would be immediately useful, while a canal would give no improvement until the whole was

completed — no sure bet considering past appropriations.

Warren agreed with Buford, Shreve, and Lee in feeling that the Rock Island Rapids was a far easier problem than the Des Moines Rapids. Low water at Rock Island gave a 2½-foot channel naturally, and this had been raised another 10 inches by damming the small channel separating Rock Island from the Illinois shore. The real dangers of the Rock Island Rapids were the crookedness of the channel and a swift, unpredictable current.

The need for improvement on the Upper Mississippi was shown by the fact that in 1853 seven steamers had been wrecked between Keokuk and St. Paul, two of them on the Rock Island Rapids and one on the Des Moines Rapids. Major Long calculated that the average loss of these boats, including wages and freight, was $50,000 per boat.[39]

Contract work on both rapids began in August 1854 and continued until November. Major John Floyd replaced Captain Barney as United States Agent supervising these projects. Although the contractors did not assemble as many men as had been hoped for, they did good work and in the short three-month season significant improvement was noted. Using the drilling and blasting methods developed by Lee, contractors at the Des Moines Rapids worked on the English Chain at the points designated on Warren's map as Centre and Brown's Patches. These points were almost entirely removed, giving Centre Patch a low water depth of six feet and Brown's Patch a depth of five feet. Contractors at the Rock Island Rapids worked at Campbell's and Sycamore Chains. At Campbell's Chain, a channel 100 feet wide and 4 feet deep was obtained.

The problem encountered with the advent of serious work on the rapids soon made those in charge aware of how optimistic early estimates had been. A single rock in Brown's Patch required two men four days to drill a hole 23 inches deep and dulled 72 steel points. At Campbell's Chain four men

took two weeks to cut off 2½ feet of rock projecting into the channel, even though breakwaters were used to protect the men from the current.[40]

Floyd foresaw that at the present rate, improvement of the rapids might take "forever."[41] He suggested that in 1855 appropriations should be doubled, work should be carried on during the two months of low water in early spring using India rubber suits for the men, and that contractors should run three shifts around the clock.

Although the two months of low water never materialized in 1855, work progressed well because of the introduction of powerful new steam equipment. Wrought iron drills with cast steel cutter heads four to six inches wide, and a new steam chisel with massive iron cleaver heads were put into operation, along with new boats designed to support them. This new equipment was apparently designed by Floyd and built by the contractors. Adapting to this new fleet delayed the beginning of work in 1855 until September 15.

During the 1855 season a new problem developed in connection with contract work. The Corps of Engineers found it increasingly difficult to find contractors to do the work, and the contractors themselves found it impossible to hire enough men to complete their contracts with the Corps. The reason was competition from the railroad companies who were building westward as rapidly as possible. The Corps of Engineers had been involved in the railroad craze in the East in the 1830's in much the same capacity as they were now on the waterways. Now railroad fever had affected most of the general public in the Upper Mississippi Valley.

This fever may account for the fact that the significant improvements finally now being carried on by the Engineers, though they had been requested by people of the Upper Mississippi for many years by memorials to Congress, pressure on Congressmen, and river improvement conventions, now went all but unnoticed in the local newspapers. The Davenport *Gazette* of June 9, 1853, noting the new appropriations for rapids improvement, claimed not to

feel much interest in it, now that the "certainty of direct Railroad communication with the East was assured."[42] Other newspapers along the river echoed similar sentiments.

Part of the excitement over the railroads involved land speculation; new towns would be made by the railroad as they had been by the rivers. Another reason for excitement was the realization that railroads would give the Upper Mississippi Valley a direct transportation route to the Eastern markets. Shippers would no longer be tied tightly to St. Louis or to New Orleans, who, aware of their strategic locations, had made use of their facilities expensive.

Public sentiment, then, was pro-railroad in 1856 when the first bridge across the Mississippi, the Chicago, Rock Island, and Pacific Rail Road Company Bridge, opened for traffic. Steamboatmen sensed an end to their transportation monopoly and complained bitterly about the location of the bridge as an obstruction to boats in the channel. There was some truth to this. The bridge had been built in the worst possible place and at a bad angle for boats passing through the drawspan. In the spring of 1856, weeks after it opened, the steamboat *Effie Afton* struck a bridge pier, wrecking both boat and bridge. The ensuing legal tangle involved Abraham Lincoln as a lawyer for the railroad company, and ended with no firm conclusion as to how much of an obstruction the bridge really was or whose fault the accident had been.

Floyd in his 1856 report to Long, now a Lieutenant Colonel, took an especially dim view of the bridge:

> It has been deemed proper by your orders not to work on the Rock Island rapids with the balance of the appropriation. Indeed, it were useless to do any more work there as long as the bridge remains to obstruct the navigation. I look upon that bridge, as now located and constructed, being situated at the narrowest point on the rapids, where the current has the greatest velocity, and the piers at an angle to the current, to be a greater obstruction to the navigation of the Rock Island rapids than all the balance of the rapids besides.[43]

Floyd had a point. Of the 1,667 boats and rafts passing the Rock Island Bridge in 1857, 55 collided with the structure.

The other Corps projects on the Upper Mississippi in 1855-56 fared as poorly. The Dubuque harbor project grew more and more complicated. On August 21, 1854, a Board of Engineers of Lake Harbors and Western Rivers authorized a survey at Dubuque to find a site most suitable for a bridge and "causey" [causeway]. The railroad bridge was to go from Dubuque across the river to Dunlieth (now East Dubuque), Illinois. Long assigned this survey to J.C. Jennings, United States Agent in charge of the harbor improvements at Dubuque, on May 31, 1855.

The need for harbor improvements at Dubuque was increasing rapidly. Commercial statistics listed 672 steamboat arrivals at Dubuque in 1854, bringing 97,633 tons of goods with a value of almost $5,000,000. Exports from Dubuque reached 11,736 tons in 1854.[44]

Agent Jennings at once began making changes in the causeway and harbor plans. He determined to change the location of the causeway and construct it with dirt from the bluffs rather than from river islands as originally called for, and he made deviations from the original harbor lines. At the same time, a Dubuque Harbor Company had been formed on February 27, 1855. This joint stock company of private Dubuque businessmen owned land near the harbor and proposed causeway. A controversy began between the Corps and the company over rights-of-way, stopping the work. Jennings failed to respond to Long's letters of inquiry during the summer of 1855, and when Long made an inspection tour to Dubuque on October 22, he found the harbor still unimproved. Disagreements were settled the following spring, but no further appropriations were forthcoming.

Work continued through the 1856 season on the Des Moines Rapids with the new steam equipment performing well. In 1856 a new blasting technique involving "galvinism" was put into use. Floyd reported to Long that now he could "set off a line of blasts of almost any length simultaneously."[45] But work on the Des Moines Rapids came to a close un-

finished at the end of the season. Later, in response to a Congressional inquiry about a possible lateral canal around the Des Moines Rapids, Floyd reported that the natural channel was adequate, and that all the engineers who had seen it felt that it could be easily expanded "to suit the exigencies and requirements of commerce, even fifty years hence; which will be far different from now."[46]

Although the Act of August 16, 1856, appropriated an additional $200,000 for improvement of the Des Moines Rapids, no further work was done on either rapids following the 1856 season. Only a small section of each rapids had been improved. The Keokuk *Whig* of September 6, 1856, reported that there was still only 20-22 inches of water on the Des Moines Rapids. A President opposed to Federal civil works, and the impending national crisis, served to dry up appropriations.

Notes

Chapter 2

1. Ralph P. Thian, *Legislative History of the General Staff of the United States Army* 1775-1901 (Washington, GPO, 1901), p. 485.

2. 2 stat. 132.

3. 1 stat. 53, discussed in Frank Smith, *The Politics of Conservation* (New York: Pantheon Books, 1966), p. 3.

4. Henry Beers, "A History of the U.S. Topographical Engineers, 1813-1863," *The Military Engineer,* XXXIV (1942), 288.

5. Richard G. Wood, *Stephen Harriman Long* (Glendale, California: Arthur H. Clark Co., 1966), pp. 38-57.

6. Stephen H. Long, *Voyage in a Six-Oared Skiff to the Falls of St. Anthony in 1817* ("Collections of the Historical Society of Minnesota"; Philadelphia: Henry B. Ashmead, 1860), p. 75.

7. General Survey Act of 30 April 1824. 4 stat. 22.

8. *Ibid.*, p. 23.

9. U.S. War Department, *Explorations and Surveys for a Railroad Route from the Mississippi River to the Pacific Ocean* (no pub., 1858), p. 25.

10. U.S. Congress, House, *Message from the President of the United States, Transmitting Copies of Surveys Made in Pursuance of Acts of Congress, of 30th April, 1824, and 2nd March, 1829,* Executive Document 7, 21st Congress, 1st Session, 1829, p. 7.

11. *Ibid.,* p. 20.

12. Florence Dorsey, *Master of the Mississippi, Henry Shreve and the Conquest of the Mississippi* (Boston: Houghton, Mifflin Co., 1941), p. 189.

13. Henry Shreve, quoted in Robert E. Lee, Survey Report to Colonel J.G. Totten, Chief of Engineers, October 21, 1839, RG 77, NA.

14. Dorsey, p. 189.

15. Douglas Freeman, *R.E. Lee, a Biography,* Vol. I (New York: Scribner's, 1935), p. 137.

16. Robert E. Lee, quoted in Freeman, p. 141.

17. *Ibid.,* p. 154.

18. *Ibid.,* p. 143.

19. A.L. Long, *Memoirs of Robert E. Lee* (New York: J.M. Stoddart and Co., 1886), pp. 41-43.

20. Lee, as quoted in Freeman, p. 144.

21. U.S. Congress, Senate, *Report from the Secretary of War, in Compliance with a Resolution of the Senate of the 25th Instant, in Relation to the Rock River and Des Moines Rapids of the Mississippi River,* Senate Document 139, 25th Congress, 2d Session, p. 6.

22. Lee, as quoted in Long, p. 45. General Brooke, whom Lee met here was apparently not a West Point graduate, but Dick Tilghman was a graduate of the class the year before Lee's. He had resigned from the Corps of Engineers at the time Lee met him at Galena, and was a civil engineer on projects throughout the Upper Midwest.

23. Lee, Survey Report.

24. *Ibid.*

25. *Ibid.*

26. U.S. Congress, House, *Letter from the Secretary of War, Transmitting the Inspection of Colonel S.H. Long, and the Report of Lieutenant Warren of his Operations During the Past Year on the Des Moines and Rock River Rapids, in the Mississippi River,* Executive Document 104, 33d Congress, 1st Session, 1854, p. 1.

27. U.S. Congress, Senate, *Report from the Secretary of War, Transmitting, in Compliance with a Resolution of the Senate Copies of Reports, Plans, and Estimates, for the Improvement of the Neenah, Wiskinsin [sic.], and Rock Rivers; the Improvement of the Haven of Rock River; and the Construction of a Pier at the Northern Extremity of Winnebago Lake.* March 25, 1840. Survey of Rock River, by Thomas Jefferson Cram, Captain, Topographical Engineers. Senate Doc. 318, 26th Congress, 1st Session.

28. John C. Fremont, *The Expeditions of John Charles Fremont,* Vol. I, Ed. Donald Jackson and Mary Lee Spenser (Urbana, Illinois: University of Illinois Press, 1970), p. 115. See also Frank N. Schubert, *Vanguard of Expansion: Army Engineers in the Trans-Mississippi West* (U.S. GPO, 1980).

29. Major Long to Colonel Abert, September 1, 1843, File 338, RG77, NA.

30. Joshua Barney graduated from West Point in 1820. He was commissioned in the Corps of Engineers but resigned in 1832. He worked as a civil engineer in service to the United States from 1844 to 1854. The title United States Agent was apparently given to civilians who supervised projects for which a set amount of money had been appropriated. They supervised such projects until the money ran out.

31. Colonel Long to Lieutenant Colonel J.E. Johnston, November 25, 1853, File 338, RG77, NA.

32. Colonel Long to Lieutenant G.K. Warren, June 1, 1853, File 338, RG77, NA.

33. *Ibid.*

34. Lieutenant Warren to Colonel Long, September 1, 1853, File 338, RG77, N.A.

35. G.K. Warren, "Journal" Warren Papers, New York State Library, Albany, New York.

36. *Ibid.*

37. *Ibid.*

38. *Ibid.*

39. U.S. Congress, House, *Letter from the Secretary of War, Transmitting the Report of Colonel S.H. Long,* p. 56.

40. U.S. Congress, Senate, *Report of the Secretary of War in Answer to a Resolution of the Senate Relative to the Improvement of the Des Moines and Rock River Rapids.* Report by John G. Floyd, United States Agent. Executive Doc. 12, 33d Congress, 2d Session, 1854, p. 3.

41. *Ibid.*

42. Davenport *Gazette,* June 9, 1853, p. 2.

43. U.S. Congress, Senate, *Report of the Secretary of War, Communicating in Compliance with a Resolution of the Senate of December 26, 1856, Information Relative to the Des Moines and Rock River Rapids, and the Harbor at Dubuque, Iowa,* Executive Doc. 45, 34th Congress, 3d Session, 1857, p. 32.

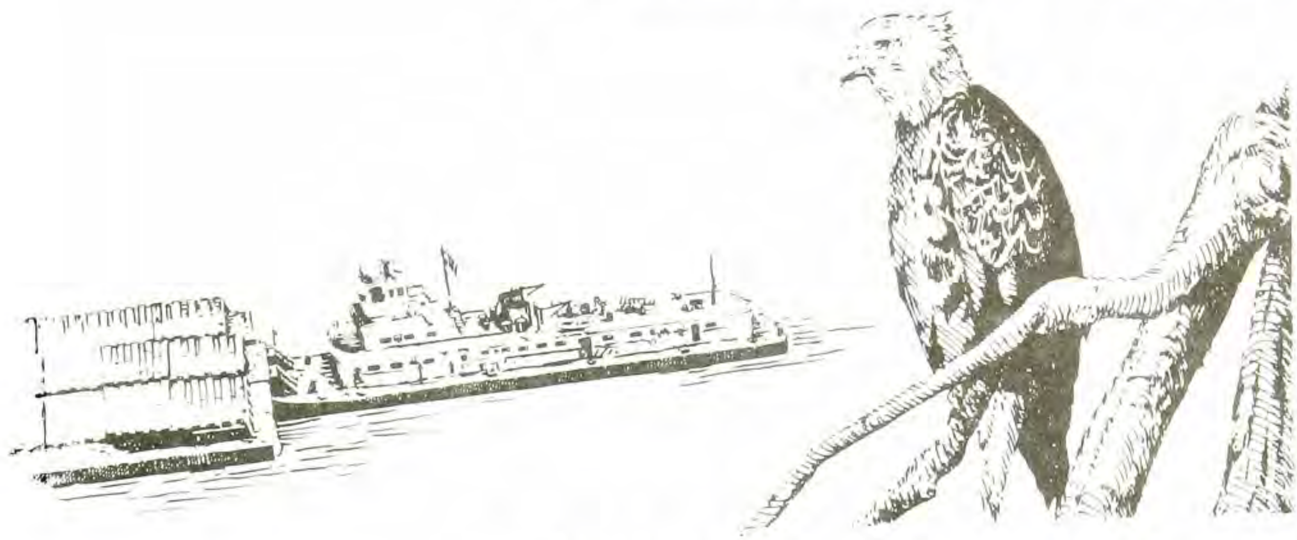
44. *Ibid.*

45. *Ibid.*

46. U.S. Congress, House, *Letter from the Secretary of War, Transmitting a Report Furnishing Information in Relation to the Improvement of the Des Moines Rapids.* Report of John G. Floyd, Executive Doc. 83, 35th Congress, 1st Session, 1858, p. 2.

Chapter 3

The Beginnings of Permanent Improvement



When the Civil War began in 1861, the Engineer officers who had learned and practiced their craft on the inland rivers were called to put their training to military use. Following the War, many of them returned to those same rivers. All of the Engineers assigned to the improvement of the Upper Mississippi following the War had served the Union well. Major G. K. Warren brought back an especially distinguished war record. Historians credit his planning and quick thinking at Little Round Top with being decisive in the North's winning the Battle of Gettysburg.

These Engineers returned to an expanded and more permanent improvement program. By the end of the Civil War constitutional questions regarding the Federal role in river improvement work (though not yet for flood control projects) had been resolved for good. The Democrats in control of Congress from 1840 to 1860 had been suspicious of internal improvements and reluctant to make appropriations, but the Republican party began its career with a declaration in favor of such expenditures. Their 1856 Platform resolved that

appropriations by Congress for the improvement of rivers and harbors of a national character, required for the accommodation and security of our existing commerce, are authorized by the Constitution, and justified by the obligation of the government to protect the lives and property of its citizens.[1]

The War had driven home the importance of internal improvements. The Mississippi River, especially, could be useful to reunite the North and the South.

Further impetus for the improvement of the Upper Mississippi came from the low water of 1864 when the Mississippi reached the lowest point ever recorded.[2] Navigation was almost wholly suspended as even the lightest boats were unable to reach St. Paul. The low water of 1864 became the mark against which all future improvement works were measured.

In addition, while traffic on the Lower Mississippi had reached its peak in the 1840's and 1850's, and had already begun to decline, the Upper Mississippi was experiencing a growth of river traffic that would not peak until the 1880's. Dissatisfied with the poor response of their representatives in Congress, cities along the Upper Mississippi began holding river improvement conventions to push for Federal money. By 1860 these conventions had become routine.[3] Two major conventions during the winter of 1865-66 attracted particular attention.

On December 15, 1865, the St. Louis Merchant's Association convened a Committee on Improvement of the Mississippi River and Tributaries. The concerns of this meeting were the rapids at Keokuk and Rock Island and the growing problem of bridges. Statistics assembled for the meeting showed that of the 910 registered vessels on Western waters (including the Ohio) in 1865, 20 listed their home port as Galena, 20 as Dubuque, 15 as Keokuk, and 39 as St. Paul. The Committee noted that in 1865 the loss of river commerce by detention and accident at the Des Moines Rapids alone was $500,000. Boats often took three to five days to navigate the eight miles of shoal water at the rapids.

The Convention also remarked on the increase in tonnage made possible by the use of barges. In 1865, the towboat *Ajax* had taken a tow of 15 barges with 300,000 bushels of coal (11,400 tons) down the river with a crew of 25. Finally, the Committee, concerned about the number of proposed bridges across the Mississippi, recommended that the drawbridges at Rock Island and Clinton, Iowa, be removed as obstructions to navigation and replaced by high bridges with a span of 50 feet above high water, and that all future bridges be of similar design.

On February 14-15, 1866, a larger and more varied convention was held at Dubuque, with rivermen, businessmen, senators and representatives in attendance. The purpose of this convention was to seek an immediate appropriation from Congress large enough to overcome the obstructions to navigation caused by the Des Moines and Rock Island Rapids.

The opening remarks at the convention echoed the sentiments of the region: "Now that 'the clangor of arms has passed away,' we may turn to the peaceful pursuits of life—the development of these vast resources that spread around us."[4]

The Dubuque convention was quick to point out that farmers and merchants in the Midwest were at a disadvantage compared with farmers in the East, since prices for grain and commodities were determined in New York. The price of grain around the country was the price at New York minus the cost of shipping it there. The price of wheat on February 2, 1866, was $1.77 per bushel in New York, $1.21 at Chicago, and $1.00 at Dubuque. An Eastern farmer who could get his grain to market for little or nothing was more than 70¢ per bushel ahead of the farmer in Dubuque, who had to ship by rail or through New Orleans and around the coast. In this kind of market, even the 10¢ or 15¢ per bushel that improving the rapids would save could aid local economy. In fact with the rapids improved, one member of the convention believed that a bushel of Dubuque wheat could be shipped to Liverpool, England, and sold for 50¢ per bushel less than its current price there.

The convention brought up another argument frequently used thereafter by both Engineers and rivermen: that improving navigation would increase competition and lower rail rates. There was some truth to that. The Illinois Central charged the same rate to ship a bushel of wheat from East Dubuque to Chicago as it did to ship the same wheat to St. Louis (more than twice the distance), where the railroad had to compete with the Illinois River and Mississippi traffic.

The Dubuque convention again raised the issue of how best to improve the Des Moines Rapids. Major Floyd, who had supervised work on the Rapids in the mid-1850's and who now lived at Keokuk, spoke in opposition to a lateral canal, as did many other critics. They pointed out that any significant increase in river traffic would make a lateral canal with locks a bottleneck, leaving the Mississippi as incapable of handling the growing commerce of the region as the railroads presently were.

In the end, however, the convention passed a series of resolutions that were similar to those of nearly every other river convention on the Upper Mississippi. The convention resolved that Federal money should be used for improvement of the rapids, that whatever the resulting improvement was it should be toll-free, and "that the mode of improvement should be left to competent engineers of the Government."[5]

In a very real way, even the railroads, already enemies of the steamboat interests, helped bring about river improvement at this point. Before the coming of the railroads, steamboatmen were content to limit improvement to the removal of snags and other dangerous obstructions. With no competition, they could charge high rates with little complaints from the merchants. The arrival of the railroads meant that more significant river improvement would have to be done to keep the steamboat competitive.

Under prodding from all these pressures, Congress moved toward much larger projects than be-

fore. They were assisted and sustained in this by a growing surplus in the United States Treasury. The beginning of permanent navigation improvement on the Upper Mississippi can be traced to the Act of June 23, 1866, which made appropriations for the repair, preservation, and completion of certain public works, and for surveys of the Upper Mississippi and its tributaries. With the understanding that a 4-foot channel was to be an eventual goal, Congress appropriated $200,000 for the Des Moines Rapids, $100,000 for the Rock Island Rapids, and $100,000 for other channel improvements and surveys north of St. Louis. These amounts were recommended by a Board of Engineers convened on March 1, 1866, and were identical with those suggested by a previous Board of Engineers which had met in 1854.

To carry out the improvements authorized by this Act, Chief of Engineers A. A. Humphreys appointed three Engineer officers to different posts. On July 31, 1866, he assigned Major G. K. Warren to duty at St. Paul. Warren was to examine the Upper Mississippi above the Rock Island Rapids as well as its tributaries (specifically, the St. Croix, Minnesota, Cannon, Chippewa, Zumbro, and Wisconsin Rivers), to examine "material necessary to determine the best manner of bridging the Mississippi from St. Paul to St. Louis so as to occasion the least obstruction to navigation."[6] He was also to determine the best means of securing a 4-foot channel from St. Louis to the Falls of St. Anthony.

Lieutenant Colonel J. N. Macomb was made Superintendent of Western Rivers Improvement outside the Ohio, with offices in Cincinnati. This post put Macomb in charge of more than 7,000 miles of waterway. His primary duty was the design, construction and supervision of snagboats. He designed and built two twin-hull snagboats along the lines of Shreve's earlier boats. Although these were primarily for the Lower Mississippi, Macomb did make several trips to the Upper Mississippi to assist Warren.

On August 3, 1866, Humphreys ordered Lieutenant Colonel James H. Wilson to take station at

Keokuk, Iowa, to superintend the improvement of the Des Moines and Rock Island Rapids, and to make a survey of the Rock River. On August 14, 1866, Humphreys further ordered Wilson to make a survey of the Illinois River from its mouth to La Salle.

Warren carried out his survey duties during August and September. He placed assistants in charge of examining the several tributaries and took charge of the survey of the Mississippi himself. Warren examined the whole length of the river above Rock Island both from shore and by packet, making careful surveys in 14 different places involving 74 miles of survey. He also considered several methods of dredging sandbars before deciding in favor of the Long Scraper previously developed by Long. The following year when Warren bought two large steamboats under his appropriation, he had them both outfitted with the scrapers.

Warren's orders of July 31 directed him to examine the Mississippi "with a view to ascertaining the most feasible means of economizing the water of the stream for insuring the passages of boats drawing four feet of water."[7] He assumed that the phrase "economizing the water" had been introduced into the Act of June 23 by Senator Ramsay of Minnesota, who agreed with rivermen and lumber interests in believing that closing side chutes and otherwise narrowing the natural channel of the river was the best means of improving navigation.[8] Although Warren was suspicious of closing dams and wing dams as means of permanent improvement, he interpreted his orders strictly, and became the first Engineer to request funds for wing dams on the Upper Mississippi. He determined to build two experimental dams, a closing dam at Prescott Island and a wing dam near the foot of Lake Pepin.

Meanwhile, Wilson went to Washington after receiving his orders of August 3 to confer with Chief Engineer Humphreys and to familiarize himself with previous surveys and reports on the Upper Mississippi. He also requested and received orders permitting him to travel back and forth to the various projects under his charge without prior individual permission.

Wilson left Washington for Keokuk sometime after August 14, using this last order to visit Chicago for supplies. He then proceeded to Rock Island where he had requested those assistants who were to undertake the surveys of the Rock and Illinois Rivers to meet him on August 20.[9] During several days in Rock Island he arranged survey parties for both rivers.[10] He sent Captain Peter C. Hains ahead of him to Keokuk and arrived himself a day later, on August 25. He and Hains took quarters at the Deming House in Keokuk.[11]

He had already made arrangements with a civil engineer, James Worrall, to undertake the Rock River survey beginning September 1. The Illinois River survey (for which he may have made arrangements in Chicago), was scheduled to begin September 10. Because the previous surveys and maps of the two rapids were not complete enough for the extent of improvement now contemplated, Wilson ordered Hains to Davenport, Iowa, to open an Engineer Office and to begin a survey of the Rock Island Rapids. Civil engineers H. A. Ulffers and E. F. Hoffmann were placed in charge of the resurvey of the Des Moines Rapids. All of these surveys were completed during the fall of 1866.

Wilson did not remain long in Keokuk. Having gotten all of the surveys well under way, he wrote a letter to Humphreys on October 1: "I have the honor to request that I may be directed to take post permanently at Davenport or Rock Island, instead of Keokuk, as either of those points is much more accessible, affords better means of communicating with the works under my charge, and greater advantages in the way of personal accommodations to myself and assistants."[12] By October 25, Wilson had received orders changing his post to Davenport, and by the first or second week of November he had moved, leaving D. C. Jenne, a United States Civil Engineer, in local charge at Keokuk.

Early Rock Island District records suggest that Wilson established a U.S. Engineer Office in Keokuk in a two-story frame building at Main Street and Blondeau, two blocks above the Missis-

The first permanent Engineer Office in Keokuk, Iowa, opened in 1866 or 1868. This photo dates from about 1875.

The first District Office in Rock Island opened in 1869 on the second floor above a wine and tobacco shop (the building with the awning) on the corner of 19th Street and Second Avenue. The Office was across from Spencer Square and the famous Harper House, a hotel well known to travelers.

The first Rock Island Federal Building, home of the Rock Island District (on the second floor above the Post Office) from 1892 to 1934. In 1934 the District moved to its present location, the Clock Tower Building on Arsenal Island.

sippi River. Wilson may have set that office up before leaving for Davenport, but more likely, he established it in the spring of 1868 when he returned to a post at Keokuk to take more direct supervision of construction of the Des Moines Rapids Canal, which was turning out more complicated than he had expected.

The Davenport Office to which Wilson moved had already been set up early in September by Captain Hains on the second floor of a building at Second Avenue and Main Street.[13]

Surveys of the Illinois and Rock Rivers

During the fall of 1866 Wilson completed the survey of that portion assigned to him, but he decided that before any plan of improvement could be recommended it would be necessary to extend the survey all the way to Lake Michigan. Part of the difficulty was the Illinois and Michigan Canal, a 97-mile waterway with 16 locks, 110 feet long and 18 feet wide, with a 6-foot depth, which had been built by the State of Illinois in 1848 to connect the Illinois River at La Salle with Lake Michigan at Chicago. The Illinois and Michigan Canal was adequate to handle traffic from the unimproved Illinois River, which was shallow but free of serious obstacles from La Salle to the Mississippi at Grafton, Illinois, but Wilson realized that it would be a bottleneck to an improved Illinois waterway.

A second problem beginning in 1865 was the city of Chicago's project to divert part of the flow of the Chicago River from Lake Michigan to the Illinois and Michigan Canal and thus down the Illinois River. The growing metropolis was having pollution problems with the sewage it dumped into Lake Michigan, and hoped to send it the other way. Reversing the flow of the Chicago River would not only affect the level of Lake Michigan, but the increased water flowing into the Illinois River would affect levels on that waterway as well. Wilson felt that no improvement plan could be determined apart from these other considerations.

Early in 1867 William Gooding, who had been the chief engineer for the Illinois and Michigan Canal, was assigned to assist with this expanded survey, authorized by Congress in the Act of March 2, 1867. An appropriation of $20,000 for this survey was made by Congress on May 8, and on May 13 Wilson received orders to organize a Board of Engineers, consisting of Gooding and himself, to conduct a survey and examination and prepare plans and estimates for "a system of navigation by way of the Illinois River, between the Mississippi and Lake Michigan, adapted to military, naval, and commercial purposes, in accordance with the act of March 2, 1867."[14]

Wilson and Gooding surveyed not only the existing route of the Illinois and Michigan Canal via the Des Plaines and the South Branch of the Chicago Rivers, but also several alternate routes, including the feeder of the Illinois and Michigan Canal which met the Calumet River at Blue Island, and a connection to the Kankakee River through the Saganaska Creek Valley to Momence, Illinois. This creek was known in the area as "the Sag" and eventually became the route of the Calumet Sag Channel connecting the Illinois River with Lake Calumet and Lake Michigan.

The plan recommended by Wilson and William Gooding was a slack water system of five locks and dams from the mouth of the Illinois River to the head of Lake Joliet, giving a 200-foot channel with a 7-foot depth of water. Part of the plan called for the Illinois and Michigan Canal to be improved to coincide with the rest of the system. The State of Illinois had been agitating the Federal Government for this improvement for some years. Wilson estimated the cost of the entire project at $18,000,000.

In 1868 Congress appropriated $85,000 for the improvement of the Illinois River from La Salle to its mouth. Wilson made examinations to select sites for locks and dams, but considered the money appropriated too small to begin work. He recommended instead that $300,000 be appropriated, the amount needed to complete one lock and dam, but this money was not forthcoming.

While Wilson waited for further appropriations, the State of Illinois went ahead with its own plans. On April 10, 1869, the Illinois State Board of Canal Commissioners began construction of a lock and dam at Henry, Illinois. The State intended this dam to give Peoria, Illinois, good access to Chicago. The Henry Lock and Dam was completed in 1871 following specifications laid down by Wilson. The lock was 350 feet by 75 feet, with 7 feet over the miter sills. The pool above the dam could be raised to 7 feet by dredging and 1-foot flash-boards placed along the dam. At the same time that Illinois began the Henry Lock and Dam, Congress appropriated $84,000 for Wilson to use on the Illinois River.

Wilson used these funds to dredge a channel 7 feet deep from the Henry Lock 59 miles downstream to the site of the next planned dam at or near Copperas Creek. This dredging project convinced Wilson that a 7-foot channel would become much too expensive to complete and maintain, and in 1870 he reduced his plan for Illinois River improvement to a 4-foot depth.

The survey of the Rock River which Wilson was ordered to make represented another continuation of the canal craze that had captured the East in the 1830's, and had already reached Illinois with the Illinois and Michigan Canal. As early as Major Long's explorations of 1823 there had been suggestions that connecting the Mississippi with the Great Lakes and the Eastern markets would be commercially desirable. The completion of the Illinois and Michigan Canal had helped Chicago to double its size in a few years.

Wilson's orders concerning the Rock River directed him to make a survey and collect information "sufficient for a project by the Rock River route with all its details, adapted to the construction of Locks, Dams, feeders, and reservoirs, for a waterway admitting the largest boats now navigating the Western and Eastern waters that form the entrance to such a Canal route."[15]

Under Wilson's direction, James Worrall began

this survey on September 1 at Fond du Lac, Wisconsin, and finished on December 1 at Rock Island. Worrall and his party had access to the latest survey instruments, but they also made do at times with materials at hand. In order to measure the surface velocity of the river, Worrall used white apples which could readily be seen passing section lines along the shore.[16]

In his report Worrall pointed to the commercial need for such a route to the Great Lakes. The rising lumber industry was already producing 4,000,000 board feet of lumber annually in Wisconsin and Michigan—more than all the new rail routes existing or being planned could handle. Iron ore from Lake Superior also needed cheap shipping to new markets.

The canal route mapped out by Worrall ran from Green Bay on Lake Michigan to Rock Island on the Mississippi. A small canal already connected Green Bay with Lake Winnebago, but the remaining 285 miles of the route surveyed by Worrall all needed improvement. Using Lake Horicon in Wisconsin as a summit reservoir to provide water, Worrall planned a system that involved the construction of 117½ miles of canal with the remaining distance running through slack water sections of the Rock River. The plan involved 56 lift and nine guard locks. Worrall drew up three separate plans with locks ranging in size up to 200 by 30 feet, large enough for the stern wheelers, but not enough for the "largest boats" called for by the Act of June 23, 1866.[17]

James Worrall was not concerned by the size and length of canal he had planned. In a letter to Wilson from the field, Worrall reported that a long canal was not an objection "in a country like this where all the appliances for making a canal have been left by nature at the engineers' disposal."[18]

In his report Worrall imagined a day when ore from Lake Superior would combine with limestone and coal from the lower Rock River, and there would arise "Birminghams, Pittsburghs, along the Rock

River."[19] That was only a beginning:

> It is impossible to foretell statistics of this country. Attempt a prediction, and it will be ridiculed as preposterously large. Let a decade of years pass over the heads of the population, and reality will have so far outstripped the highest-colored, most visionary anticipation.[20]

Eventually, wrote Worrall, the cities of the Rock River—Fond du Lac, Beloit, Rockford, Sterling, Dixon—"all to be Buffalos, Rochesters, Uticas, in a shorter time than it took to develop the cities on the Erie Canal."[21]

Wilson's section of the Rock River report was much more conservative. He pointed out the limitations of the summit reservoir and the tremendous expense, estimated at nearly $15,000,000, for the project. This report was submitted to Congress on April 11, 1867, but no action was taken.

Improving the Rapids

While the surveys of the Rock and Illinois Rivers were being carried out by his assistants, Wilson was busy examining the results of the resurveys of the two rapids made by his staff. By January 1, 1867, he was ready to report his recommendations for improvement. For the Rock Island Rapids Wilson determined to follow the plan generally recommended by Buford, Lee, Shreve, and Warren to excavate and straighten the existing channel. At the Des Moines Rapids, however, he departed from the recommendations of most previous Engineers and determined to construct a lateral canal along the Iowa shore, a modification of the plan suggested in 1836 by Henry Shreve.

In order to understand the different problems presented by the two rapids, it is important to note how structurally varied they were. The Upper Mississippi River was formed during the four glacial ages of the Pleistocene epoch, and is not old as geological history goes.

Prior to the first of the ice sheets the Mississippi flowed down through central Iowa to just south of

Muscatine, then curved west around the present Des Moines Rapids. Then the Nebraskan Glacier pushed the channel over to its present location down as far as Clinton, Iowa. Here the edge of the ice sheet forced the river to run over hard rock rather than seek its natural valleys. The river over a long period of time scoured down through this rock creating the deep valley hemmed in by bluffs that characterize the region today. From Clinton south the river went west around both the Rock Island and Des Moines Rapids.

Then the Kansan glacial age arrived several hundred thousand years ago and pushed the channel of the river east from Clinton until it met the Illinois River at Hennepin; from here it flowed with the Illinois River to St. Louis. As this glacier retreated it left a large flat plain in central Iowa in which valleys formed for the Cedar, Iowa, and Skunk Rivers. These three rivers joined just above Keokuk and came down over the present Des Moines Rapids. From here they flowed south to join the Mississippi River where the mouth of the Illinois now is.

During the third glacial age, the Illinois Glacier moved the Mississippi toward the west. It blocked the Cedar and Iowa Rivers and formed Lake Calvin, which covered much of central Iowa. Lake Calvin drained south over the Des Moines Rapids.

Finally, about 20,000 years ago, the Iowa and Tazewell Glaciers came together near Clinton during the Wisconsin Age and forced the Mississippi over the Rock Island Rapids. By the time these glaciers had retreated, the river had adopted nearly its present channel.

The last glacial sheet, the Mankato, arrived about 12,000 years ago and deposited huge amounts of gravel, silt, and sand near St. Paul. This eventually filled in the riverbed as far south as St. Louis. Erosion of this gravel bed left the valley with its characteristic terraces at the 25-and 75-foot levels. Wilson noticed these terraces. He pointed out that the town of Nauvoo was built on the 25-foot terrace while Sandusky was on the 75-foot level.

The Des Moines Rapids, then, is older by thousands of years than the Rock Island Rapids, while the sandbars that caused so much trouble for navigation and so many problems for the Engineers are even more recent. Partly as a result of the age difference, the Des Moines Rapids were shallow but smooth, while the Rock Island Rapids were still rough.

Wilson brought with him to his work a thorough understanding of the geological theories of his time. The glacial theory was still too recent in 1866 for him to be aware of its details, but his examinations of the geological features above the Des Moines Rapids led him to the current conclusion that the Rapids had once been the outlet of a large Iowa lake.[22]

Warren proved to be even more astute in his geological observations. He not only correctly assumed that the Mississippi had previously scoured a large valley which had subsequently partly refilled with sand (an assumption that helped determine the nature of improvement projects), but he also accurately charted the old channel of the river that had originally come down west of Keokuk before it filled in, sending the river across the Des Moines Rapids. Warren was also the first person to suggest, based on his survey of the Minnesota River in 1867, that the Minnesota River Valley had once been the outlet of Lake Agassiz, the ancient lake that covered a large area of mid-America. Warren reported these findings in a paper presented to The American Association for the Advancement of Science of Chicago in August 1868.[23] In 1884, in honor of Warren's discoveries, this ancient river from Lake Agassiz was named Glacial River Warren.[24]

Warren did not spend as much time speculating on the Rock Island Rapids, but here, too, he was correct in concluding that the channel had once gone from Clinton to Muscatine, by-passing the rapids.

The Rock Island Rapids consist of seven chains of rock projecting into the channel from both the Illinois and Iowa shores. These begin with Lower

Chain near the foot of Rock Island (now Arsenal Island) and are scattered for 14½ miles upstream to Upper or Smith's Chain near Le Claire, Iowa. Not all of the chains reached all the way across the river. Between chains pilots could generally find deep water even during the low water season. The real problem on the Rock Island Rapids was not shoal water, but the narrow, tortuous channel that passed near one shore or the other, back and forth several times in the course of the rapids, forcing boats to the danger of moving sideways against the swift rapids current. Of the 14 miles of rapids, 11 miles were good water. Only three miles were difficult or dangerous. The problem for pilots was knowing where those three miles were.

Because a pilot who did know by heart where the bad stretches were could get a boat across the rapids in all seasons, a thriving business in piloting the rapids grew up in Le Claire at the head of the rapids. Captains would find these rapids pilots gathered under the Green Tree, a famous Le Claire landmark used as a guide by river pilots, and hire them to steer their boats through the channel to Davenport.

The rapids at Keokuk were completely different. Here the river in wearing a channel had come across an 11-mile-long strip of rock much harder than the rock above and below it. This was a layer of cherty limestone of the Keokuk series inclined at the same slope as the river. Rather than being constructed as a typical rapids, the Des Moines Rapids ran over a relatively smooth rock bed which behaved exactly like an artificial dam with deep water behind it. In several places through the 11 miles the water had worn indentations and holes, but they were not connected. During low water these rapids were almost impossible to cross. The shoal stretches of these rapids, too, were called chains, but they were not the kind of chains found at Rock Island. The water surface showed none of the traditional ripples common to other rapids, making it difficult for pilots to know where the deeper water was.

These two obstacles to navigation provided the

Rock Island District with its first real test of the Engineers' ability to adapt, to experiment, and to solve unique problems.

The Rock Island Rapids

In making assignments in September of 1866, Wilson ordered Captain Hains to Davenport to supervise the Rock Island Rapids Improvement. Hains was instructed to make a detailed survey of places on the rapids where boats experienced shoal water, swift currents, or twisting channels, and from this to make an estimate of the excavation necessary to make navigation on the rapids safe. He was also to locate the Rock Island Bridge on his maps, ascertain the direction of currents through the bridge and assess the general influence of the bridge on navigation. Finally, he was to find out how much underwater rock excavation might cost using the different methods available.

Hains completed his field work in September and convened a Board of Engineers at the Davenport Engineer Office on December 19 to consider alternate methods of improvement. In addition to Hains, the Board included three civil engineers: D.C. Jenne, in local charge of the Des Moines Rapids, and James Worrall and W. F. Shunk, who had made the Rock River survey.

The board considered three possibilities. Overcoming the rapids by locks and dams (three would be needed) was rejected because of a principle adopted early in the work that "no plan should be adopted for the improvement of navigation in low water that would be prejudicial to its present state in high water."[25] The second possibility was a lateral canal which would leave the main channel open for use in high water. But the Board chose the third alternative, improvement of the natural channel, as the best. A lateral canal would be expensive and would not be useful until the whole project was finished, while each small improvement of the natural channel would show immediate results. In addition, a lateral canal would need an annual appropriation for operation and maintenance.

One potentially serious objection was raised to widening and deepening the natural channel. The chains of the rapids acted as a series of dams which held the water back in the pools behind the chains. Some rivermen argued that opening the natural channel would let the water through faster, not only increasing the already treacherous current but also lowering the water level along the entire rapids and making them an even worse obstruction. The Board had made careful calculations and were convinced that this would not happen, but it was a recurring argument that Warren had had to answer as early as 1854.[26]

The Board recommended that the present steamboat channel be enlarged to 200 feet wide by 4 feet deep, that the excavated material be deposited in the river bed so as to check cross currents and confine water to the main channel, and that wherever possible, excavation take place by the use of coffer dams. The cost of the improvement was estimated at just over $800,000.

In the spring of 1867 Wilson decided that the Hains survey was still not in sufficient detail to begin work and assigned Lieutenant E. F. Hoffmann to make a survey. Hoffmann, one of many employees of the Rock Island District who gave long years of devoted service to Upper Mississippi River improvement, began work at the end of May and completed soundings in August. He remained with the District as a civil engineer after resigning from the Army, and from 1870 until his death in 1884, served as engineer in local charge of improving the Rock Island Rapids. At the time of his death, the original project was virtually complete.

A contract for rock excavation was made with Case and Co. of Fulton, New York, in June of 1867. The first work began on the Duck Creek Chain that fall under the supervision of District engineers. Between September 8 and October 15 a coffer dam was built around the area to be excavated. Water was pumped out and the work of quarrying began on October 22, continuing until December 20 with an average force of 128 men per day.

With their work on the Rock Island Rapids, Engineers of the Rock Island District developed a procedure they were to use in succeeding river projects. Rather than beginning at one end of the rapids and working methodically to the other, cutting the channel to its required dimensions, they began with the worst obstruction first, then moved on to the second-worst, and so on. This "little-here, little-there" policy must have looked terribly uncoordinated and unplanned to an outside observer, and it did not show immediate and dramatic results, but it was appreciated by the river captains and pilots.

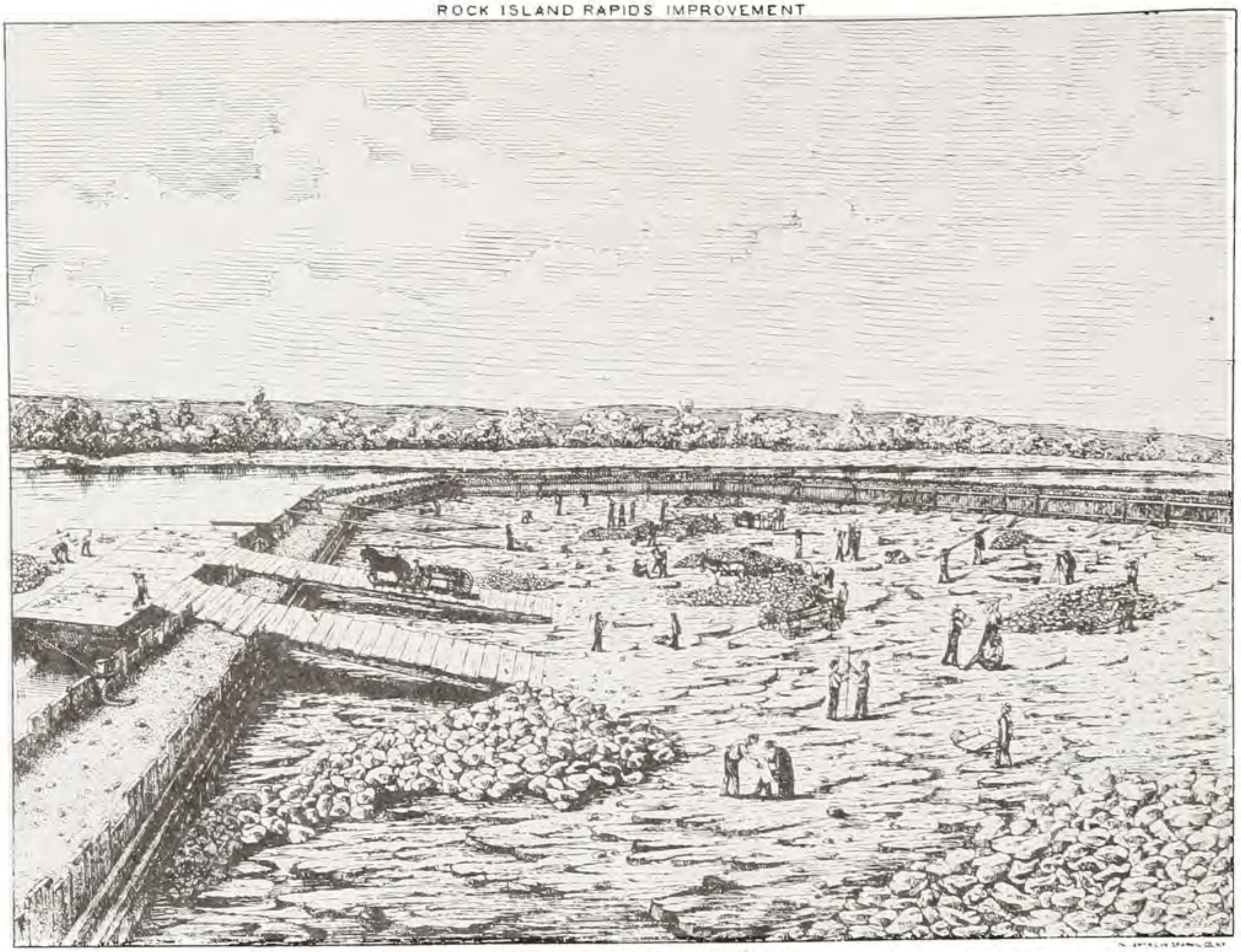
Three methods were used to excavate rock on the Rock Island Rapids. The most frequent was by coffer dam and subsequent quarrying rock. Coffer dams were typically used where the river was shallow, from 6 to 14 feet, though a coffer dam at one point on Sycamore Chain reached 25 feet. Prior to work on the Rock Island Rapids, engineers in both Europe and America had fastened such dams in place with iron rods sunk 15 inches into the rock bed. These 2-inch rods were placed in parallel rows 10 feet apart. Contractors and Engineers at Rock Island believed that a coffer dam would remain in place of its own weight. They proved to be right, effecting a significant saving of effort and material.

Coffer dams were constructed by forming a breaker ahead of the dam, then putting the dam down. The dam itself consisted of two parallel timber walls running from 10 feet apart at the head of a dam to 8 feet along the sides. The walls were braced and held together with flat iron tie rods secured by washers and pins. The walls were then filled with a mixture of clay and gravel (puddling) pumped from the river bed. Following this, the water was pumped out of this work area.

The smallest of these coffer dams enclosed an area of 2.26 acres on Upper Chain; the largest, at Campbell's Chain, enclosed 43.07 acres using 5,780 feet of dam.

Quarrying the rock was done mostly with hand

ROCK ISLAND RAPIDS IMPROVEMENT



SKETCH OF COFFER-DAM AT LOWER CHAIN.

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Rock excavation inside a coffer dam on the Rock Island Rapids, the predominant method of excavation on the rapids project. This sketch was drawn by Henry Bosse, a draftsman in the District Office during the 1880's.

drills and blasting powder. Steam drilling was tried during 1868-69, but did not work well. Drill bits varied from 1½ to 2½ inches. Holes were drilled from 1½ to 4 feet deep. Then the water was sponged out, the holes filled with clay and drilled again to make a watertight hole. One pound of powder was used for each $^{7}/_{13}$ cubic yard of rock. The broken rock was then taken to the shore, or carried up inclines built to the top of the dam, where it was transferred to flatboats and dumped outside the channel.

Coffer dams generally worked well, but they were subject to two hazards. Passing steamboats were not always as careful as they should have been in their attempts to make time (and therefore money). In the treacherous currents of the rapids, they frequently ended up colliding with the dams and delaying the work. Second, the Mississippi was subject to sudden spells of high water, causing several dams

(which were built no higher than absolutely necessary) to flood.

Where coffer dams were not practical because of a deep or very uneven bottom, or where the area to be enclosed was too small, rock was removed by chisel boat and dredge using equipment similar to that developed by Major Floyd in 1853. The chisel was a 12-inch square beam 12 feet long suspended between iron rails over the downstream end of the chisel boat. The beam was headed by a conical shoe of wrought iron with a steel point welded to it. Until 1872 when a Mr. A. J. Whitney invented exchangeable points, the whole 3½-ton chisel had to be shipped by rail to Chicago for frequent sharpenings. In addition to the slowness of operation, chisel dredging invariably missed spots, and very careful work was necessary to clean up all the broken rock.

A unique method of rock excavation on the Rock Island Rapids project. A large rock in the channel near Campbell's Chain was heated and then cracked to pieces by buckets of cold water.

Coffer dam excavation and chisel dredging were supplemented by a small amount of submarine blasting carried on between 1875 and 1880 at St. Louis and Moline Chains. Never as successful as other methods, blasting was accomplished by

Drilling tripods and a derrickboat being used to blast and remove rock from the Rock Island Rapids. These tripods were not very different from those devised by Captain Robert E. Lee for work on the Des Moines Rapids in 1837.

timber tripods erected to rest on the river bottom. A narrow platform was built around the outside of the tripod at the water level. Here two men operated the drilling equipment and stuffed holes with blasting powder. When a large area was to be blasted, a chain of tripods was erected and connected by catwalks. The broken rock was removed by ring bolts split at the straight end, with a wedge inserted in the split. The bolt was driven into cracks in large pieces of broken rock, where it wedged tight. The rock was then lifted out onto flatboats by the use of boom dredges.

One particularly large rock in the channel near Campbell's Chain succumbed to Corps ingenuity in an especially interesting manner. This rock, sometimes above water and sometimes below, depending on the season, was a constant hazard to navigation. It was on this rock that Lieutenant John Campbell and his men became grounded in July of 1814 while

fighting Indians in the westernmost battle of the War of 1812. The Indians, allies of the British, attacked the helpless boat, killing 16 men and wounding 21, including Lieutenant Campbell who lay near death for several months.

The rock was finally destroyed in 1870. While it was exposed during a period of low water, cordwood was piled on its surface and set afire. When the flames died down a crowd of men with buckets threw cold water on the hot rock, causing it to split and break into pieces. Explosives were placed in fissures that remained and the rest of the obstruction was blown apart.[27]

Work on the 4-foot channel through the Rock Island Rapids continued until the 6-foot channel project in 1907 made it necessary to revise the whole plan. In 1851 a veteran riverman had appeared at a river improvement convention at Burlington, Iowa, and offered to undertake to improve the Rock Island Rapids to accommodate the largest boats for $20,000 "for the simple reason that he could make money by doing it."[28] That proved to be a rather low bid. By 1886 when the project was finished with the exception of several small isolated patches, the Corps of Engineers had supervised the removal of 87,926 cubic yards of rock at a net cost of $1,166,608.[29] The final cost of the project by 1907 was $1,508,458.

The Des Moines Rapids

The Des Moines Rapids had long been a more annoying obstruction to navigation on the Upper Mississippi than the Rock Island Rapids. Many groups in addition to the Engineers had made attempts to improve them before Wilson arrived in 1866. From 1829 to 1866 the Corps of Engineers had spent $335,000 on the rapids, though only about 25,000 cubic yards of rock had been removed. More of the money had been spent on surveys, experiments, and preparations for the different plans suggested than in actual work.

Private groups had developed several plans for getting around the rapids. In 1837 a charter was granted to a private company for the Des Moines Rapids Railroad which was to run along the Illinois side from Warsaw to Commerce (later Nauvoo). The promoters felt that this would be the most valuable rail line in the United States, carrying steamboat cargo around the rapids.[30] The company ran into financial difficulty before the road could be built, but the Mormons who had recently moved to Nauvoo intended to carry the project out until their leader Joseph Smith was killed in 1844. Such a rail line at this time might have been a success. Nearly 300,000 tons of merchandise was carried around the Des Moines Rapids in 1837.[31]

Private individuals and groups made several attempts to build dams at the rapids for both power and navigation. A wing dam of earth covered by stone was built at the head of the rapids in 1841. Water from this dam powered a grist mill for two seasons before the dam washed away. A similar attempt at Nauvoo in 1842 met a like fate. When Joseph Smith was killed the Mormons had been planning a larger project that might have been successful. Smith planned to construct a large dam nearly all the way across the river to Montrose, leaving only a small channel open. The dam was to have provided power, and the closure of the channel was to have backed up the river, giving Nauvoo a deep harbor.

In spite of these dreams and actual attempts, navigation over the Des Moines Rapids had not significantly been improved by 1866. During low water steamboats still had to transfer their cargo to lighters or to a railroad on the Iowa side which began running from Keokuk to Montrose in 1856. Passengers, too, had to make this transfer, going by rail or stagecoach.

The business of lightering was an old one at the Des Moines Rapids. Father Francis Xavier, who travelled in the area in 1721, wrote about the rapids where passengers were obliged to unload and carry their pirogues.[32] When the French fur trade developed, the Sac and Fox Indians set up villages near

the future sites of Nauvoo and Keokuk to serve as guides on the rapids. When Lieutenant Zebulon Pike came up the Mississippi in a keelboat in 1805, he was met by a party of Sac lightermen who relieved his boat of 31 heavy barrels of supplies so that it could cross the rapids.[33]

Later, the towns of Montrose and Keokuk arose to support the lightering trade. By 1850 there were two shipyards at Montrose specifically for the repair of lighters (which received hard usage). Lightering employees, called "ratters," developed what was perhaps the first union west of the Mississippi to protect their interest.

As Warren had discovered in 1854, lightering was costly to the steamboat industry. In 1866 an average steamboat crossing the rapids in low water spent $500 per day in lost time and wages, in addition to the $1 per ton lighter freight charge, plus the cost of labor to load and unload goods from the steamboat and transfer them to and from the lighter. Wilson estimated that the 90 days of low water during the 1866 season had cost boats passing the rapids $250,000 in extra labor in addition to the $1 per ton for freight. This meant that the Des Moines Rapids was costing farmers, merchants, and steamboatmen of the Upper Mississippi Valley a half million dollars a year. During the 1867 season the Northern Line Packet Company alone paid $200,000 in lighterage fees.[34]

The need for rapids improvement was pressing. By 1866 the five states bordering the Mississippi above the Des Moines Rapids were producing between one-half and one-third of the produce in the United States. Three hundred and four steamboats with value of more than $10,000,000 were serving the Upper Mississippi. In addition, the lumber industry was coming into its own. More than 400,000,000 board feet of lumber was being rafted downriver annually. The Des Moines Rapids alone added 2% to the price of this lumber.

Wilson found previous maps of the Des Moines Rapids of little help in determining the best method

of improvement. Lee's map he found to be of use only as a general picture, and Warren's map, though more detailed and accurate, was limited to illustrating the project for excavating a natural channel. Wilson put civil engineer H. A. Ulffers in charge of a resurvey, assisted by E.F. Hoffmann. During this survey, which took the entire fall to complete, Ulffers and Hoffmann made between 40,000 and 50,000 soundings of the rapids.

The Des Moines Rapids extended for 11¼ miles from just above Keokuk to just north of the village of Montrose. Gentle waves in the continuous rock shelf which comprised the rapids were identified as chains. There were five of these: Lower, English, Lamallee's, Spanish, and Upper.

Wilson investigated several methods of improving the rapids at Keokuk. He rejected the earlier plans of Buford, Lee, and Warren to excavate the natural channel because the expense involved in cutting a channel through the whole 11¼ miles of rock would be prohibitive, and because a narrow channel out in the river, where the surface would not indicate its whereabouts, would be difficult to use during the day and impossible at night or in fog. Both day and night boats would be liable to be blown out of the channel onto the rapids.

Wilson rejected locks and dams for the same reason that they were rejected on the Rock Island Rapids: they would be a hindrance in high water. Several local groups made proposals to Wilson, but the only feasible one seriously investigated came from "certain parties in Illinois."[35] This was to build dams of rock and brush in cribs across the river to within five or six hundred feet of the Iowa shore. From here a rock and brush wall would be built parallel to the shore for one mile downstream. One of these L-shaped dams was to be built at each of the five chains. The constricted channel would act as a sluiceway, shooting steamboats over the chains. Wilson rejected this plan because he felt such dams would not withstand the movement of ice in the spring.

Based on the evidence he had assembled, Wilson decided on a lateral canal as the best solution. This was the plan which Henry Shreve alone had recommended in all previous Corps of Engineer surveys, but which rivermen had long favored. Editorials in the Keokuk *Gate City* before and after Wilson's arrival show strong sentiment for a canal. Two days before Wilson arrived one headline read: "Know you not, Oh! city reader, that Keokuk can be made the Lowell of this Western Country, if we but have a canal?"[36] A canal was endorsed by the Keokuk City Council two days after Wilson arrived, and on October 3, representatives of the Merchant's Exchange met with Wilson to push for a canal.

A lateral canal on the Iowa side of the river was not a recent idea with Keokuk residents. They had long favored such a canal as the best way of improving the rapids and serving Keokuk's interest at the same time. Local residents had never agreed with the plans proposed by Lee, Floyd, and Warren for improving the natural channel. After repeated attempts to get Congress to listen had failed, Keokuk had acted on its own. On January 15, 1849, Iowa Governor Ansel Briggs had approved the Iowa General Assembly's authorization of the "Navigation and Hydraulic Company of the Mississippi Rapids" to acquire right-of-way for a canal. The estimated capital stock needed to complete the project was put at $500,000.[37]

As chief engineer the company hired a former West Point graduate, Class of 1831, Samuel R. Curtis. Curtis had served on frontier duty at Fort Gibson, Indian Territory; had resigned in 1832 to become chief engineer of the Muskingum (Ohio) River Improvement Organization, where he had attempted to use locks and dams to make that shallow river navigable; had served as a lawyer before joining the Ohio Militia during the Mexican War (during which he was appointed Adjutant General); and had most recently (1847-49) served as chief engineer for a Board of Public Works created by the Iowa General Assembly to improve the Des Moines River by locks and dams.

General Curtis, as he came to be known in Keokuk, was a man who dreamed large. He had surveyed the Des Moines River as far as Ottumwa by 1849, and foresaw a day when the Des Moines River valley would have canal connection to the St. Peter's [Minnesota] River and others, leading to nationwide trade connection for Iowa's coal and gypsum. The sandstone cliffs along the Des Moines "that have stood for ages as silent and gloomy sentinals guarding the clear bright river that flows at their base will be rent by the blast and broken by the workmen, and their fragments will be removed and erected into mansions."[38]

Curtis entered his new duties with the rapids canal company with the same enthusiasm. His engineer's report recommended that a canal and wing dam improvement be built from the Upper Chain at Montrose down to the upper end of Keokuk. The canal was to be constructed by building an embankment out in the river, then excavating the space between the embankment and the shore. Curtis' plan called for one lock at the foot of the canal with a lift of 24 feet, the only difference between his and Shreve's plan, which had not called for any locks. Curtis also felt that the canal could be used for an enormous mill-race to generate enough hydroelectric power to operate "all the machinery that human invention can locate within reach of its influence."[39]

When the money backing the project turned out to be inadequate, General Curtis left for several years to practice law and survey for railroads in Iowa, but he returned to Keokuk in 1856 and was elected mayor. His inaugural address in May 1856 called for an even larger and better canal around the rapids. Keokuk would become a "port of entry" with 2,000 steamboat arrivals a year. Curtis envisioned a canal two or three hundred feet wide which would serve as a "great steamboat harbor" all the way from Keokuk to Montrose, and which would be "sufficient to safely moor all the steamboats of the upper Mississippi."[40]

From 1857 to 1861 Curtis spent three terms in Washington as a U.S. Representative. He joined the

Second Regular Iowa Volunteers during the Civil War and returned home to Keokuk in the spring of 1866. Although General Curtis died in December 1866 shortly after Wilson arrived, his long and enthusiastic interest in a Des Moines Rapids canal must have been an important contribution to the Keokuk canal fever which met Wilson. The plan which Wilson finally adopted was close to that suggested 17 years before by Curtis.

Wilson's report on the Des Moines Rapids recommended that a navigation canal be built along the Iowa shore from Keokuk to Nashville, a distance of 7.6 miles. From Nashville to the Upper Chain boats would use the natural channel, which was deep enough without improvement. At the Upper Chain Wilson proposed to cut a channel 200 feet wide, 6 feet deep, and 2,400 feet long. The canal itself would have a 300-foot width and a 6-foot depth, with three locks. The 6-foot depth recommended by Wilson was two feet more than called for in the Act of June 23, 1866, but he accurately predicted that within 50 years the low water depth of the Mississippi would be increased to six or seven feet.

Wilson decided on a canal as the best method of improvement because it would leave the natural channel free both during and after construction, because it would be easy to navigate, and because, with its slack water, the canal would be an especial aid to boats ascending the rapids. During high water, shallow draft boats and log rafts could use the natural channel if they wished.

The actual plans and estimates for the canal were done by Wilson's assistant, D. C. Jenne, who had previous experience in canal construction. Jenne's estimate of $3,390,000 to build the canal was not too far off, but his estimate that the work could be done by 1869 was eight years too short.

Chief of Engineers Humphreys found Wilson's report satisfactory and presented it to the House of Representatives in early February 1868. Here the Committee on Commerce considered it and made provisions for the canal in the general appropriations bill. However, objections arose in the Senate

when doubts were raised about the canal plan, considering that all previous Engineer reports had rejected the idea of a canal. The Senate voted the bill out and in its place appropriated $500,000 for "improving navigation at the Des Moines or lower rapids, according to such plan as the Secretary of War shall, on the report of a board of engineers, approve."[41]

Accordingly, Humphreys convened a Board of Engineers which met at Keokuk on April 16, 1867, to examine the rapids and make recommendations. The Board consisted of Wilson, T. J. Cram, Macomb, Warren, Hains, and W. Milnor Roberts, who had been superintending engineer improvements on the Ohio River. After examining the rapids, the members of the Board adjourned until April 30, when they reconvened at the U.S. Engineer's Office in Davenport and remained in session until May 13.

In addition to the plans Wilson had previously considered, the Board investigated several alternatives, including the possibility of dams across the entire river, Livermore's Improved Chute, and Brunet's Improved Float Gate for sluices in dams. The latter was a hollow gate hinged so that when the desired level of water in a sluiceway was reached the gate could be flooded, sinking it horizontally on the bottom, permitting the boat to ride the crest thus produced.

In the end the Board's recommendations were almost identical to Wilson's original proposal, except that some of the dimensions were reduced. On July 19, 1867, the Board reported its results to the Secretary of War, who had been given power to make the final decision. He instructed Wilson to "proceed at once to carry out the plan of improvement reported by the Board."[42]

The Board had decided that the canal was to be built by constructing an embankment in the water to form the river side of the canal, then excavating the prism between the embankment and shore to obtain a 5-foot depth. The embankment was to be built first because, being built out in the river, it was the

most uncertain part of the construction; because once built, it would serve as protection for the excavation and for building the locks; and because the total of $700,000 now appropriated for the canal would just about complete the cost of the embankment.

Wilson advertised in newspapers throughout the country in July for bids to construct the embankment and prism. Bids were opened September 4 at Davenport, and on September 25, 1867, he signed a contract with William Henegan and Son of Mt. Vernon, Ohio.[43]

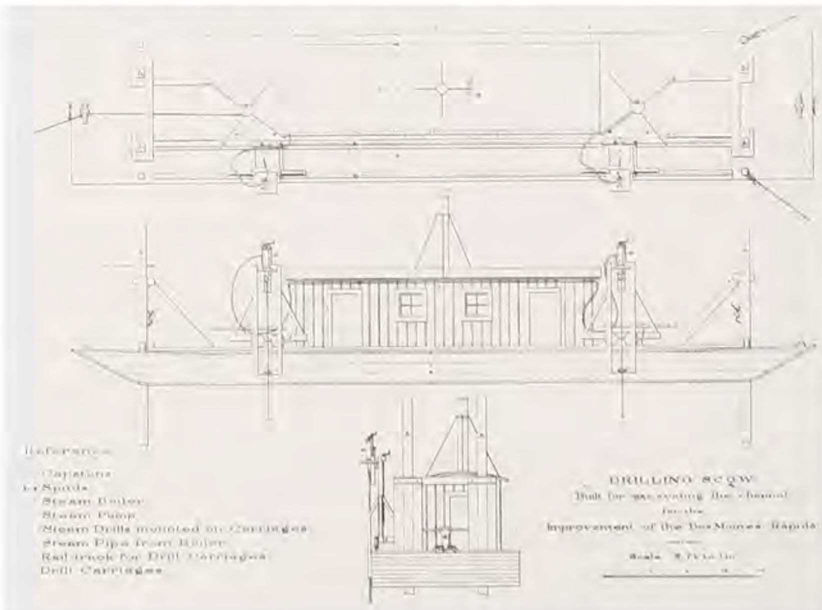
On October 18, 1867, Wilson and his assistants, and William Henegan located the centerline of the canal, and moved the first wagon load of earth for the guard bank connecting the outer embankment of the canal with the shore. Regular work crews began the next day.

Almost immediately the contractor fell behind schedule. The boats he had promised to provide had not yet arrived at the end of November, and fewer men had been hired than were necessary to keep on schedule. Nevertheless, there was some progress. By March 1, 1868, 5,000 feet of earth embankment had been laid seven feet high, and 5,280 feet of rip rap wall had been put down. On shore, 7,500 feet of new rail line and 76 rods of public highway had been completed to replace those taken by the project. One casualty of the canal construction that could not be replaced was the tow path along which horses used to haul lighters up and down the rapids.

Early in March Wilson foresaw that problems with the contractor on the Des Moines Rapids would increase. With the work at the Rock Island Rapids going smoothly, Wilson requested that his station be changed from Davenport to Keokuk. He received permission to do so, and by April 10, the headquarters of the Rock Island District had moved to Keokuk. Wilson retained this office in Keokuk until he retired in 1870. At that time, Colonel Macomb moved the office permanently to Rock Island.

After repeated admonitions from Wilson, Henegan and Son were declared to have violated their contract on October 26. Perhaps realizing that they had undertaken too much, the contractors made little protest. Until a new contractor could be found, Wilson and his assistants took over the work using hired labor and the machinery left behind by Henegan. That machinery included four small boats (not powered), 18 double teams, 13 carts, 66 railroad cars and two locomotives. The two locomotives had been built especially for this project, and were part of the shortest, smallest railroad in Iowa. The 4-foot gauge track ran from the quarry on shore out over the top of the embankment. They were extended as the embankment was built. The locomotives had two pair of 3-foot drive wheels and resembled switch engines except that they lacked a pony truck in front. Flat cars hauled stone from the quarry while dump cars hauled earth. There is some irony in the fact that the Rock Island District came into possession of a railroad and horse teams before it owned a single steamboat.

Contractors were not the only problem for Wilson. The guard embankment was safely out in the river, but the prism crossed land owned by people. Some of it was farmland; other places had developed businesses on the land. At one place the Gibbonsville



Plan for a steam drilling scow built for the Des Moines Rapids Canal project. Because of the experimental nature of most of the improvement work in the 19th century, the Rock Island District designed and built much of its own equipment.

Distillery stood on the way. Both highway and railroad had to be relocated. Wilson had funds to indemnify the owners of property taken or damaged by canal construction, but by the end of 1867, the claims of those willing to make a "reasonable" settlement amounted to only $15,500.[44] Many others hoped to get more money from a jury settlement, and others did not want to sell at all. At least one injunction had already been issued by an Iowa court prohibiting the contractors from entering private property along the canal line.

Humphreys early in 1868 requested the Governor of Iowa to get the Iowa Legislature to amend the Iowa statutes "so as to enable the Government of the United States to enter upon any and all lands of quarries adjacent to the work referred to and necessary to its progress."[45] Land claims were eventually settled, but not before these legal problems had delayed construction for a time.

On November 28, 1868, a new contract was signed with J. J. Dull of Harrisburg, Pennsylvania, who bought all the old machinery. The work went better under this contractor. During the 1868 season the average work force had been 15 foremen, 113 laborers, and 104 quarrymen. By 1870 the canal force was up to 1,000; it reached 1,600 by 1875 as the canal neared completion.

Dull added equipment as the work progressed. Eventually he had four locomotives, 500 flat and dump cars, and 20 miles of track. The main track ran atop the guard embankment, with spur lines to the pits and to the quarries on the shore.

The embankment in the river was constructed by laying down a rip rap toe of broken rock taken from a quarry at Price's Creek or excavated from the prism. Rail tracks were laid down on this foundation, and the railroad was used to haul the dirt necessary to complete the embankment. The finished embankment was about 20 feet high and 10 feet wide at the top. Much of the dirt and rock in the embankment came from the points of land extending from the shore line of the canal into the prism which had to be removed to even the shoreline.

Because the railroad tracks were temporary, constantly being moved and extended as the work progressed, and because they rested on settling ground, accidents were frequent. Cars and locomotives regularly tipped over, resulting in many crushing injuries and several deaths among workmen.[46] Nevertheless, the little engines worked hard. They hauled cars, pulled out stumps, whistled for lunch, and even towed lighters up the rapids, replacing the horses and towpath that had been taken for the improvement work.

The railroad was also used to show visitors around the construction site. The Des Moines Rapids Canal project attracted attention in magazines and newspapers throughout the United States, with frequent stories on the progress of the work. As a result, engineers and other visitors came to visit and inspect the work. To accommodate these visitors, a special flatcar was outfitted with board seats to haul visitors around the site. Famous visitors showed up, too. On February 24, 1868, Horace Greeley, who had come to Keokuk to give a lecture, spent the day being shown around the construction.[47]

Most of the work on the canal was hard hand work. All of the earth from the prism was removed by hand with shovels and wheelbarrows after a huge, horse-drawn plow had loosened the dirt. At regular intervals along the canal, temporary cross embankments were built from the outer embankment to the shore. The resulting sections were called "pits," and in each of these, a pit crew of up to 60 men worked. A majority of laborers who worked on the canal were new immigrants from Sweden, and many of the remainder were Irish. These workers lived in shanties rented at a nominal sum from the contractors, who had built them all along the shore from Keokuk to Montrose.[48]

When the rock bottom of the prism was reached, it had to be blasted out, again by hand, using drills to make the holes and black powder to do the blasting. Steam drills were used where blasting had to be done underwater, and tin tubes extending to the

surface of the water were used to load the powder charges. Such charges did not break up the rock very effectively, but they made noise. Local residents reported that for 25 or 30 miles around, the canal construction sounded like a distant battle.[49]

The finished embankment contained a total of 884,325 cubic yards of earth in addition to 97,000 cubic yards of rock excavated from the canal prism and from the chains at Nashville and Montrose. The embankment varied between 60 and 90 feet at the base, with a slope of 1½ to 1. It varied from 16 feet high at its lowest point to 27 feet at its highest.

Within the prism of the canal were two lift locks and one guard lock, completed between 1870 and 1874 after the embankment was finished. The locks were built under a separate contract. The lower lift lock was located at Keokuk; the middle lock was 2.5 miles above the lower; and the guard lock was $\frac{1}{10}$ mile above the middle lock. At each of the locks a 27-foot-square stone engine house held the 30 horsepower steam engines used to operate the locks. This machinery was manufactured from an original design of Major Amos Stickney, who assumed local charge of the canal in 1872, and was manufactured at the Buckeye Foundry in Keokuk. The engines operated pumps which provided hydraulic pressure to open and close the gates, permitting the use of only one man at each of the locks to operate the gates.

The locks were constructed of magnesian limestone laid in hydraulic cement. The stone was quarried from the Sonora Stone Quarries on the Illinois bluffs adjacent to the river. The rough blocks of stone were taken across the river by the light draft steamer *Cricket* to stone yards at Nashville and Price's Creek. Here the stone was dressed and numbered, and then taken to the site by rail. The lock gates were built of cedar and cypress wood which proved to be so sturdy that when the gates were removed for repairs 25 years later, workmen had trouble taking them apart.

Each lock provided a chamber 310 feet long by 80 feet wide at the surface, giving it a usable length of

291 feet by 78 feet. Larger boats could be locked through by maneuvering and using one gate at a time, but the only regular steamboat larger than 291 feet on the Upper Mississippi was the 302-foot *St. Paul.* The locks were filled by culverts which led to the gate recesses, and they were discharged by openings in the chamber wall. Depending on the river level, a lock could be filled or emptied in from five to ten minutes.

Delays caused by changes in contractors, by contractors' unfamiliarity with problems encountered, and by limited appropriations postponed completion of the Des Moines Rapids Canal far beyond its projected 1869 date and nearly doubled the costs. The Engineers frequently had to wait for new appropriations before resuming work.

Wilson also ran into another problem that caused delays in these early years of improvement work: the conflict between the District Engineer's perceptions of how to proceed with the work at hand, and the insistence of the Office of the Chief of Engineers

The guard lock at the head of the Des Moines Rapids Canal. This was not a lift lock. Rather, it kept out debris and provided slack water in the canal.

Middle lock at the Des Moines Rapids Canal, 2.5 miles above the lower lock at Keokuk, Iowa.

on strict observance of military orders and adherence to the letter of the law in contracts. Wilson was not permitted the kind of autonomy that Rock Island District Engineers later in the 19th century enjoyed after OCE and the District had learned better how to cooperate. The process by which Districts were given some allowance to adapt procedures to their individual needs was a gradual learning experience, and Wilson and Washington had just begun to learn.

Some of the problems Wilson encountered with regulations were annoying but minor. In January 1868 one of Wilson's civil engineers, Robert Shanley, needed to have $2.25 worth of repairs done to a survey instrument. Wilson's request for payment of this sum to Shanley (who had paid the repairer out of his own pocket) was returned from OCE because "it is not perceived how, under the regulations, this voucher can be paid without the presentation of a sub-voucher from the person making the repairs."[50] A month later both voucher and the new sub-voucher were returned to Wilson be-

cause "the sub-voucher must state that the payment was received *from Mr. Shanley*. The auditing officer requires this particularly."[51] Mr. Shanley was finally reimbursed late in March.

Wilson had similar small problems with OCE over the official number of times bid advertisements had to be inserted in newspapers, and over the hiring of workmen. Wilson discovered that he needed written authority from the Chief of Engineers to hire each clerk, foreman, and overseer, but that it was left to the discretion of the officer in charge to hire as many rodmen, chainmen, axemen, and boatmen as he needed. Correspondence on each of these items took time and helped prolong the work.

More serious than these minor irritations were problems which arose from a strict interpretation of the rules regarding contractors. Wilson, for instance, felt that it would be good economical procedure to let contracts that would stop when any given appropriation ran out. This loose type of contract would have permitted Wilson to use the contractor for whatever seemed necessary at a given time, to handle unexpected problems arising from the kind of unfamiliar work being done at the canal. This would have made the contractor more like a supervisor of a work force of hired labor, to be used as the Engineer in charge saw fit. Standard procedure, however, was to let bids on one specific job which could be done within existing appropriations, and this is what Colonel Wilson was held to.

Wilson also objected to another OCE policy, the requirement that he let out bids for new contracts each year as new appropriations became available. This meant that contractors such as Dull, had to bid anew each year on each job at the canal. Each of the sections of the canal and each separate lock, for example, were under separate contracts. Wilson had such good working relationships with J. J. Dull during the first year that he requested OCE to permit him to continue contracting with Dull without new bids. This was denied, new bids were let, and eventually five sections of the prism were under five different contractors, Dull submitting the low bid for

only one of the sections. By 1874 the contract work proved so unsatisfactory that the project was taken over by the Government using hired labor and completed that way.

On at least one occasion, Wilson's persistence did win a change of mind from OCE. When the excavation of the prism reached the rock bottom early in 1869, the contractor discovered that the rock to be blasted lay in uneven layers, and that it was impossible to excavate the prism exactly in every place to a four-foot depth. The rock came out in layers, and to get a minimum depth of four feet, parts of the prism had to be excavated deeper. Dull requested payment (which was contracted by the cubic yard) for all of the rock actually removed, and Wilson supported that request, noting that planes of stratification seldom coincided with the line of cutting. OCE, however, pointed out that "the contract calls for a channel 200×4 feet. The wording, spirit, and intention of this contract is clear that just so much rock is to be removed as will give the depth of water specified and no more . . . the question of stratification should not be regarded."[52] OCE authorized Wilson to annul the contract with Dull, but he continued to plead their case, and on June 19, 1869, he received permission to pay the contractors for the extra rock removed.

Other delays at the Des Moines Rapids Canal had nothing to do with OCE, the lack of money, or defaulting contractors. The Upper Mississippi weather and the river itself continually conspired to show their power. One manifestation of this power occurred as the last section of the canal was being completed—the cutting of a channel through the Montrose Chain above the canal.

On August 24, 1875, contractors completed a coffer dam on the Montrose Chain enclosing 95 acres of river. On September 3 the dam sprang a leak, flooding the work in 40 minutes. This leak was repaired by September 8, but on that day an unusually heavy rainstorm raised the small streams throughout the Upper Mississippi basin, and the river rose to the heights of the spring floods. The high water

threatened the dam, so the contractors made a cut in the dam and flooded the pit. But the difference in elevation between the head and foot of the coffer dam caused a strong current which washed away 600 feet of the dam, and created a cross-current which caused a heavy passing log raft to float in and unship the engine and pump at the lower end. Engine, pump, and a number of small tools were lost in the river.

The water continued high, so repairs to the dam were not completed until October 12, at which time 900 men were put on the job of excavating until January 2, 1876. Then a repeat of the September 8 flood washed the dam away. This time the Chief of Engineers was consulted, who determined to go ahead. The dam was rebuilt and contractors began pumping water out on January 31. During the pumping a cold snap formed six inches of ice on the water inside the dam, which, settling on the tracks in the pit, causing considerable trouble. After removing the ice, the men resumed work on February 7.

Three days later, on February 10, a recurrence of soft weather and heavy rains threatened another overflow. A dredge was at hand, and by continuous effort for three days and nights, workmen raised the walls of the coffer dam above flood level.

With the river met and temporarily conquered, work resumed until February 24, when appropriations ran out and the work halted. By this time all but a small patch at the head of the chain had been completed. A series of hardships this extended might have been unusual, but such disappointment was an ever-present companion in the work of navigation improvement.

The canal itself was not immune from troubles caused by contractors' sub-performance and the whims of nature. In the spring of 1875 a large leak developed under the canal bank one-half mile below the middle lock. Engineers discovered a crevice in the bed rock of the river two to four feet below grade which was pouring thousands of gallons of water into the canal. To get at the crevice, half of the em-

bankment for a length of 500 feet had to be removed, the channel excavated, and the crevice exposed and filled with concrete.

The Des Moines Rapids Canal was not opened to traffic until 1877. It had cost $4,155,000. On the morning of August 22, the Rock Island District sidewheel snagboat *Montana*, with District Engineer Macomb on board, and with colors flying, bands playing, and spectators who thronged both boat and shore cheering loudly, entered the guard lock at the head of the canal, becoming the first boat to enter. At 5 p.m. the Keokuk Northern Line steamer *Northwestern* entered the lower lock, passed the *Montana*, went up to the head of the canal and came back at 9 p.m. Colonel Macomb reported that "the adjacent bluffs were lined with spectators."[53] The steamer *War Eagle*, one of the grandest boats on the Upper Mississippi, brought a large delegation from St. Louis for the event, but she ran aground on a sandbar below the rapids and missed the ceremonies.

Problems with the embankment of the canal caused it to be closed for repairs on September 10 after only three weeks of operation. It was opened again on September 22, but closed for 15 days on October 1. On October 11-12, 1877, at a meeting of the Mississippi River Improvement Convention (one of the conventions that led to the formation of the Mississippi River Commission two years later), the canal came in for severe criticism by rivermen. "Twelve years for nothing," one of the speakers called it. Protests against the Corps of Engineers included charges that the Government had hired a steamer at $50,000 per year to throw hunting parties for those building the canal.[54]

Present at that convention was a relatively new employee of the Rock Island District, Montgomery Meigs. Meigs was the son of Lee's assistant in 1837, and was an assistant engineer at the Rock Island Office with the rank of United States Civil Engineer. When Meigs was given a chance to answer these charges, he outlined the problems, most of which he charged to contractors' failure to put the

rock down correctly in the embankment, in so clear and reasonable a way that the members of the convention and the reporters present accepted his explanation. The mood of the convention toward the Corps of Engineers changed, and Meigs was referred to thereafter by the convention members as either "General" or "Major" Meigs.[55] Although Meigs had never been in the Army, the "Major" stuck, and throughout his long career with the Rock Island District, he was known as Major Meigs.

Montgomery Meigs grew quite knowledgeable about the Upper Mississippi and about District operations as he served a series of District Engineers as an innovator and advisor. In 1884 he was put in local charge of the Des Moines Rapids Canal at Keokuk where he remained until his retirement in 1926.

The Des Moines Rapids Canal continued to serve steamboats on the Upper Mississippi until it was flooded out in 1913 by Lake Cooper, the long pool of water that backed up behind the new Keokuk water

Lower lock at the Des Moines Rapids Canal, with construction already underway on the Keokuk and Hamilton Water Power Company Dam.

power dam. As part of the agreement with the Corps of Engineers, the Keokuk and Hamilton Water Power Company built a larger single lock as part of the dam. Montgomery Meigs remained in charge of these new facilities. The 60-mile pool behind the dam also flooded out the last vestige of the Des Moines Rapids.

Other Activities on the Upper Mississippi 1866 to 1877

While Wilson supervised the improvement of the Rock Island and Des Moines Rapids, Warren worked at his several projects between St. Paul and the Rock Island Rapids. In the fall of 1866 he began the surveys assigned to him. These were general surveys to locate areas needing improvement and to determine methods for doing so. Based on the surveys completed by the winter of 1866-67, Warren published a preliminary report on January 21, 1867, in which he recommended that money be appropriated for a lock and dam at Meeker's Island, for building and operating two dredge and snagboats, and for small experiments with wing dams, closing dams, and beacons—a total of $340,465.[56] Warren also requested $775,500 for a 4-foot channel between St. Louis and St. Paul, or as an alternative, $117,000 for a 2- or 3-foot channel.

On March 2, 1867, Congress appropriated money for two snag boats for the Upper Mississippi, one snag and dredge boat for the Wisconsin River, and $37,000 for removing snags and boulders from the Minnesota River by contract.

Warren had also been assigned to survey the Wisconsin River for a possible route from the Mississippi to Lake Michigan similar to those surveys of the Rock and Illinois Rivers assigned to Wilson. In 1867 Warren completed an extensive survey of the Wisconsin River and laid down a canal route from Portage City to Prairie du Chien. Warren considered a canal the most reliable means of obtaining navigation between Green Bay and the Mississippi. He estimated that such a canal following the

natural river valley and using the Wisconsin River for crossings would give a 4-foot depth for just over $4,000,000.

Both Warren and Wilson realized that Congress would probably not fund any such major project, but they knew that Congress would certainly not fund two major routes to the Great Lakes, and a friendly rivalry grew up between the two. Neither man actually favored such a project at all. According to Warren, he "had a private understanding with [Brevet] General Wilson in 1866 that neither of us should go into this business."[57]

However, the appropriation by Congress of $85,000 for actual improvement work on the Illinois River in 1868, brought a hurried request from Warren for funds to buy another boat for the Wisconsin River project. The appropriation for the Illinois River, wrote Warren, "compels me to commence on the Wisconsin work at once to keep even with General Wilson."[58] Even more displeased were representatives of the Green Bay and Mississippi Canal Company, who had much to gain by a Wisconsin River route. "These Wisconsin men," wrote Warren, look upon the Illinois appropriation "as a trick of the Illinois politicians to steal a march upon them, and get judgment from the Engineer Department in favor of the Illinois route over the Wisconsin route."[59] Knowing the ways of Congress, Warren agreed that spending even a small amount of money on the Illinois River "will thus place this improvement on the list of works 'in course of prosecution by the government.' "[60]

Following completion of his surveys, Warren next looked into purchase of the snag boats provided for in the March appropriations. Following adjournment of the Board of Engineers which met at Keokuk to consider the Des Moines Rapids in the spring of 1867, Warren left for St. Louis and Cincinnati to examine available boats which could be adapted to snagging operations. He returned to St. Paul on June 9. In June Warren placed advertisements in several newspapers inviting bids for selling steamboats to the United States to be used for scraping sandbars; he also advertised for contracts to remove snags from the Minnesota River.

A satisfactory bid was received for snagging the Minnesota River, but bids for snag boats were too high and involved unsuitable boats. Early in September, Warren returned to St. Louis and, after careful examination, decided to buy two sidewheel steamboats, the *Montana* for $30,000 and the *Caffrey* for $8,500. Warren had already purchased several small skiffs and a quarterboat for his surveys the previous fall, but these two boats were the first Corps-owned steamers on the Upper Mississippi. In September of 1868 Warren bought a third boat, a small steamer *Winneconne* for $8,500. The *Winneconne* was intended for the Wisconsin River improvement, but proved to have too great a draft.

Prior to the spring season of 1868, Warren adapted the *Montana* and *Caffrey* for both dredging and snag operations. Both boats were fitted with a Warren adaptation of Long's Scraper. Long's Scraper was a triangle of massive oak timbers attached base downward at the stern of the vessel. This triangle was raised or lowered by purchase rigging, and steadied by a heavy oak beam attached to the stern of the boat and running through a slot in the triangle. Attached to the bottom of the base timber were half-cylinder scrapers set lengthwise with the keel of the boat. At the head of a bar, the scraper was lowered until it was a few inches below the existing riverbed. The boat then backed downstream. As the scrapers plowed up the bottom, the churning wheels washed the material dredged out of the channel, where the current carried it away and deposited it downstream. One scrape across a bar took from four to ten minutes. Depending on the size of the bar, clearing a channel deep enough for steamers to pass took from an hour to an entire day.

In addition to scrapers, the *Montana*, the larger of the two boats, was strengthened at the bow and outfitted with boom machinery for snagging.

Warren's experiments in channel improvement showed gratifying results the first season. During 1868 the *Montana* worked 67 days and the *Caffrey* worked 112. When the *Caffrey* began work on July 12 the water was so low that large boats could not

navigate. The scraping of bars by the *Caffrey* made it possible for all boats to operate for the rest of the season. The one problem with scraping as a means of channel improvement was that it was not permanent. The next cycle of high-low water would leave an entirely new set of bars up and down the channel.

Warren also pioneered the marking of the channel to guide pilots during the 1868 season. When the *Montana* or *Caffrey* had put a section of channel in good condition, the crew would place guide boards on either side of the river along the banks. The guide boards were three-quarters- or one-inch boards held together by cleats, about five or six feet square. They were painted white with a large red cross in the center, and fastened 20 or 30 feet above ground on trees. Steamboat pilots at first ridiculed these guides, but by the close of the season there was universal acknowledgment of their benefit, especially on dark, cloudy nights.[61]

In the fall of 1868 Warren was sent West as a special commissioner to examine the construction of the Pacific Railroads under direction of the Secretary of the Interior.[62] He did not return until June of 1869.

When Warren returned, it was to take charge of construction of the new railroad bridge at Rock Island. This bridge had been authorized in 1866 when the Government determined to relocate the tracks of the railroad to the southwestern tip of the Island of Rock Island to facilitate use of the island as a United States arsenal. A new bridge for that location had already been designed by Brevet Brigadier General Thomas Jefferson Rodman, Commandant of the Arsenal. The bridge was to include two levels, one for the railroad and the other for a wagon road. Specifications called for a drawspan with two clear openings, each 160 feet wide, for steamboats, and a span for rafts next to the draw 250 feet wide.

In the spring of 1869 the Government decided to place the job of actual construction with the Corps of Engineers, partly to permit better coordination

The Rock Island Bridge, built under the supervision of Major Gouverneur K. Warren and Colonel John N. Macomb in 1869-72. Warren designed the machinery on which the 366-foot drawspan still pivots, however. It was the heaviest drawspan operating on that principle yet built.

with navigation problems. Disagreements over the bridge had existed throughout the planning stages. Some interests wanted the wagon road on the upper level; others felt it should be on the lower. Original plans called for a double-track bridge, but General Rodman had also designed plans for a single-track bridge.

There were also money limitations. Congressional authorization for the bridge stipulated that the Government and the railroad company share the cost equally, with the Government half not exceeding $1,000,000. Because of these problems, only the piers had been contracted for, designed so they could take either a single- or a double-track bridge.

Warren assumed that with the bridge already designed, he would have little to do; and he intended

to turn the actual construction over to Major Amos Stickney as soon as the construction had begun. It was not, in the first place, a design with which Warren agreed. Among his other 1866 duties, he had been assigned to investigate and report on the construction of railroad bridges across the Mississippi. The book length report which resulted was not published until 1878, but in it Warren clearly demonstrated his belief that the wellbeing of steamboats ought to be a prime factor in the design of such bridges. He had recommended in that report that all bridges have spans of up to 500 feet wide, and high-water clearance of as much as 100 feet.[63]

It is no wonder then that Warren made changes in General Rodman's design to favor the boats. He redesigned and relocated the drawspan, placing it next to the island shoreline (which General Rodman claimed would interfere with steamboat landings at the Arsenal), and he included two raftspans, one in the channel and one next to the Iowa shore, to account for different river conditions. Next, he reversed Rodman's design and placed the railroad on the top level and the wagon road beneath so as not to let the trains frighten the horses with sparks, smoke, and noise coming up from below. He made the bridge single-track, with the wagonway 30 feet above low water and the railroad level 12 feet above that. The 366-foot drawspan which Warren designed to operate on a pivot was by far the heaviest drawspan operating on that principle yet built.[64] Though much of the bridge has since been redone, the pivot machinery is still in good operating condition. The Rock Island Arsenal Bridge was 1,546 feet long and cost $999,261 to construct, just within the $1,000,000 limit.

On August 3, 1869, in order to supervise construction of the bridge, Warren requested that his office for bridge matters be changed to Rock Island, retaining his St. Paul Office for other works in his charge. On May 27, 1869, Wilson's sub-office in Davenport had also been moved to Rock Island, perhaps because boats were easier to dock on the Rock Island side of the river.

Warren was occupied with bridge construction until the following June when he was put in charge of the Lakes Survey with headquarters in Detroit, ending his long service to the Upper Mississippi River. He was replaced by Colonel John N. Macomb, who had been Superintendent of Western River Improvement.

Macomb established his office on the second floor of a commercial building at the northeast corner of 19th Avenue and Second Street in Rock Island. This office was across the street from Spencer Square and the Harper House, one of the notable hotels in the Mississippi Valley. These quarters remained as the main office of the Rock Island District until 1896, when the Corps moved into the newly completed Federal Building.

When Wilson resigned from the Army in October of 1870 to become Vice-President of the St. Louis and Southeastern Railroad, Macomb assumed his duties in addition to Warren's.

Under Macomb work continued on the Rock Island Bridge. By the fall of 1872 it was nearing completion. On November 18 running ice in the Mississippi stopped the ferry between Davenport and Rock Island. In response to a request from the Arsenal, Macomb opened the bridge to wagon traffic the next day, though trains had been crossing the bridge since October 8.

The *Montana* and the *Caffrey* continued to operate with success. During the 1872 season the *Montana* ran 4,089 miles and the *Caffrey* ran 2,641 miles in pursuit of their duties. By 1877 when Major Farquhar assumed command of the Rock Island District, both boats were beginning to show the effects of hard work. 1877 was the last season for the *Caffrey*. Because of low appropriations that year, she was not put in commission, and was sold soon after. The *Montana* continued to operate until the close of the 1878 season, when she was rebuilt into a completely different boat.

By 1873 the partially improved Rock Island Rapids were less of an obstruction than the channel

north to St. Paul. Under Macomb the first permanent improvement of this section of the river was begun in 1873 when the crew of the *Montana* closed the chute at the head of Pig's Eye Island, five miles below St. Paul, after navigation had become blocked there. A jetty was built from the head of the island to the eastern shore, followed by similar jetties at Rollingstone Bar and at the head of Betsy Slough above Winona, Minnesota.[65]

These jetties were built by driving piles close together and then placing two-inch planks on the upstream side. When the *Montana* returned to Pig's Eye Island, she found that the jetty had given way. C. W. Durham, who was in charge of the experiments, decided to build a wing dam by driving two tiers of poles along the length of the dam nine feet apart, and filling the space with willow brush weighted down with sacks of sand. The finished wing dam was 600 feet long and varied between six and ten feet high. Within days, this dam had opened the channel. Furthermore, it remained open, a permanent improvement.

Macomb also continued the work which Wilson had begun on the Illinois River, dredging the channel and building wing dams. In 1875-77 a second lock and dam was built at Copperas Creek, with the Government laying the foundation for the dam in 1875 and the State of Illinois completing the project by 1877. The more extensive lock and dam system proposed by Colonel Wilson was still in doubt because of the out-of-date Illinois and Michigan Canal, and because the courts had still not decided just how much water to let the City of Chicago divert from Lake Michigan down the Illinois River.

During the Engineers' work on the Illinois River, the civil engineer in local charge, Robert McMath, developed a mechanical sounding machine that was used for some years after in the Rock Island District. The problem with hand soundings, in addition to the time and expense (remember that the Des Moines Rapids required between 40,000 and 50,000 soundings), was that it was hard to get a clear picture of the bottom, especially the bumps

and ridges which even close soundings often missed. McMath's machine operated like a pantograph, recording a continuous profile of the ground passed over by the boat using the machine. Macomb tested this machine and recommended it to the Government, which purchased it.[66]

On November 15, 1877, when Macomb was placed in charge of Defense and Harbor Improvements on Delaware Bay, the Illinois River project was assigned to Captain Garrett J. Lydecker of the Chicago District. The remainder of the Illinois Waterway story can be found in the Chicago District history.[67] In the nine years from 1869 to 1877, the United States had spent $344,000 on the Illinois River, $235,000 of this for dredging.

By 1877 steamboat and barge arrivals from the Upper Mississippi and Illinois Rivers at St. Louis had exceeded those from the Lower Mississippi, the Missouri, and Ohio Rivers. In 1877, 834 boats arrived at St. Louis from the Upper Mississippi, while 780 arrived from the Lower Mississippi. The Illinois River sent 252 boats to St. Louis, while 145 arrived from the Missouri and 139 from the Ohio River.[68] The improvement work done by Wilson and Macomb shares some of the credit for this.

Macomb also undertook the first comprehensive surveys of the Upper Mississippi under an 1874 appropriation for Transportation Routes to the Seaboard.[69] Warren's surveys in 1866 had only been at selected locations. If the Corps of Engineers was to develop a plan of permanently improving the channel, they would need a more complete survey.

Consequently, when Montgomery Meigs joined the Rock Island District in 1874, his first assignment was to carry out such a comprehensive survey. A quarterboat, the *Hoffmann* (named after the engineer in charge of the Rock Island Rapids), built just for this survey, was finished on August 27 and towed to St. Paul by the *Montana*.

With C. W. Durham as his assistant in charge of the sounding party, Meigs began the survey at

Frenchman's Bar, 1½ miles below St. Paul on September 2. There was only time and money to do the worst stretch of river, that part between St. Paul and La Crosse. In that area the survey crew located 44 sandbars that were obstructions to navigation. Twenty-three of these had three feet of water or less at low water.

The quarterboat *Hoffmann* did not use a steamboat on this trip to move from location to location. Instead, Montgomery Meigs rigged up a sail which proved satisfactory enough to maneuver downstream. Meigs reported that he kept the boat close to shore because "she doesn't have very good sailing qualities."[70] During this trip he also adapted a rowboat for use on Lake Pepin by adding a false keel and installing a sail he bought from a fisherman for \$2.50.[71] These were the first examples of Meigs' tinkering that would eventually produce a superb fleet of boats for the Rock Island District fleet.

In his report of this survey, Meigs recommended that wing dams similar to the one constructed at Pig's Eye Island be used to constrict the channel in order to deepen and scour it. In 1878 when the Government adopted the 4½-foot channel, wing dams became the predominant method of achieving the goal.

Notes

Chapter 3

1. Lippincott, p. 632.

2. *Annual Report*, 1892, II. p. 1760.

3. Lippincott, p. 633.

4. *Proceedings of the Mississippi River Improvement Convention Held at Dubuque, Iowa, Febuary 14 and 15, 1866* (Dubuque, Iowa: *Daily Times*, 1866), p. 3.

5. *Ibid.*, p. 39.

6. U.S. Congress, House, *Letter from the Secretary of War, in Answer to a Resolution of the House, of December 20, 1866, Transmitting a Report of the Chief of Engineers, with General Warren's Report of the Surveys of the Upper Mississippi River and Its Tributaries*, Report of G. K. Warren, Executive Doc. 58, 39th Congress, 2nd Session, 1867, p. 2.

7. Major G. K. Warren to Chief of Engineers, August 27, 1866, File 25, Letters Received, RG77, NA.

8. *Ibid.*

9. James Worrall to Lt. Col. Wilson, August 16, 1866, Rock Island District Historical Files.

10. Colonel J. H. Wilson to Chief of Engineers, August 26, 1866, File 25, Letters Received, RG77, NA.

11. Keokuk *Gate City*, August 26, 1866, p. 4.

12. Colonel Wilson to Chief of Engineers, October 1, 1866, File 25, Letters Received, RG77, NA.

13. *Davenport City Directory for 1870.*

14. War Department, *Annual Report*, 1867, p. 270.

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17. *Report of Brevet Maj. Gen. James H. Wilson*, pp. 2-8.

18. Worrall to Wilson, October 17, 1866.

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20. *Ibid.*, p. 9.

21. *Ibid.*, p. 10.

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23. Major G. K. Warren, "On Certain Physical Features of the Upper Mississippi River," *American Naturalist*, II (1868), pp. 497-502.

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29. *Ibid.*, p. 1428.

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33. *Ibid.*, p. 363.

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39. Curtis, quoted in "The Des Moines Rapids Canal," p. 120.

40. Samuel R. Curtis, "Mayor Curtis's Inaugural," in Orion Clemens, *City of Keokuk in 1856* Keokuk, Iowa: O. Clemens, 1856), p. 10.

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43. Unless otherwise noted, the material here and on the following eight pages comes from the *Annual Reports*, 1867-1870.

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45. General Humphreys to Governor of Iowa, January 9, 1868, File 22, RG77, NA.

46. Wilson, "The Des Moines Rapids Canal," p. 126.

47. *Ibid.*, p. 129.

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49. *Ibid.*, p. 123.

50. OCE to Colonel Wilson, January 21, 1868, File 22, RG77, NA.

51. OCE to Colonel Wilson, February 15, 1868, File 22, RG77, NA.

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65. *Annual Report*, 1874, I, p. 302.

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67. John Larson, *Those Army Engineers, A History of the Chicago District U.S. Army Corps of Engineers* (Washington, D.C., GPO, 1980), pp. 185-231.

68. *Annual Report*, 1879, II, p. 1198.

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Chapter 4

Stopping the Leaks: the 4½-Foot Channel

When Major Francis U. Farquhar became District Engineer on November 15, 1877, the Rock Island District was firmly established as a force on the Upper Mississippi River. The period of experimentation and isolated projects was coming to an end. The Des Moines Rapids Canal had just opened, the Rock Island Rapids were navigable, and the experiments with wing dams and dredging had proved their point.

There were still critics who talked about "Humphreys and his corpse of engineers,"[1] but all along the river the Corps was growing up. The controversial Eads Jetties at South Pass had been authorized on March 3, 1875. The ship channel which they had scoured to the Gulf of Mexico had once again made water shipment to New York competitive with the railroads. By 1878 the jetties had proved themselves, increasing the demand for further improvement of the channel up to St. Paul.

River improvement conventions which had grown to be a popular means of applying pressure to Congress before the Civil War now increased in number and voice, all requesting far more extensive channel

improvement. Conventions met at St. Louis in 1867, 1872, 1873; at New Orleans in 1869, 1876; at St. Paul in 1875, 1877; at Prairie du Chien in 1868. Even after passage of the 4½-foot channel project conventions continued to keep the pressure on and the appropriations coming.

District Engineer Colonel Alexander Mackenzie attended one of these conventions at St. Louis in 1881, shortly after the improvement work had begun. The members were interested in exactly what the Corps intended to do, and how fast, but Mackenzie, after answering a few brief questions, asked to be excused "inasmuch as I would greatly prefer, as heretofore, to carry on the practical work, than to appear as a public speaker."[2] Privacy, however, was a luxury that Rock Island District Engineers were increasingly forbidden. As District activities became more complex, public relations became an inevitable part of a District Engineer's responsibilities.

The Act of June 18, 1878, authorized a 4½-foot low water channel from St. Paul to St. Louis, to be accomplished by contraction of the channel through wing and closing dams. Eventually, this was to be increased to 6 feet. The Act appropriated $250,000 for improving the channel from St. Paul to the Des Moines Rapids, and $100,000 for channel improvement from the rapids to the mouth of the Ohio River.

The 4½-foot channel project caused a change in the method of operations in the District from many scattered duties to one unified project. When Major Farquhar became Rock Island District Engineer he assumed command of 17 separate river improvement projects ranging as far as the Red River of the North. On July 15, following passage of the 4½-foot channel, Farquhar was relieved of all improvement work above St. Paul. Even operation of the Des Moines Rapids Canal was placed under the separate command of Major Amos Stickney. The 4½-foot channel became the single most important reason for the Rock Island District's existence.[3]

Preparation for channel improvement was begun even before Congress authorized the project. During the winter of 1877-78, Farquhar had a general map of the Mississippi River drawn up. The map covered the river from the Falls of St. Anthony to the mouth of the Illinois River, and was a composite of all previous maps and surveys in the Rock Island Office. The map was photolithographed in 26 sheets and distributed to rivermen with the hope that it would induce a more uniform nomenclature of localities, a needed step for river improvement.

After the 4½-foot project was passed, the first action was to make yet another survey of the river. The survey made by Meigs in 1874 had only gotten as far as La Crosse. In 1875 C.W. Durham had continued Meigs' survey to Keokuk, but no thorough survey had been made south of the Des Moines Rapids. Even the sections of the river that had been surveyed had changed so much in four years that the Meigs and Durham surveys were useless.

Consequently, the first comprehensive survey of the Mississippi from St. Paul to Grafton, Illinois, was begun under Farquhar during the 1878 season, and finished in the fall of 1879. Seven separate survey parties were assigned sections of the river. Each party consisted of 24 men: two assistant engineers, one pilot, three recorders, one clerk, a transit party of six, a level party of four, a sounding party of five, and laborers to build sounding stations. Equipment for each party included a 34- by 8-foot steam launch, a 40- by 10-foot quarterboat (used as a cookhouse and office), three rowboats, and five 12- by 12-foot tents. The whole camp moved 8 to 12 miles at a time.

The map prepared from this survey was published in 83 sheets, and excluded only the Rock Island and Des Moines Rapids.

Major Farquhar also continued the practice begun by Macomb of dividing the District up into sub-sections (called "districts" or "divisions" in District correspondence). Farquhar placed an assistant engineer in charge of each sub-district. By June

of 1879 when Mackenzie arrived as District Engineer, there were five of these sub-sections. This practice allowed each Engineer to become familiar with the peculiar problems encountered on his stretch of river — an important asset, considering the short tours of duty of District Engineers. These assistants got to know the contractors and other citizens in their area, and helped make the work of the Corps more personal.

Preparations were made during 1878 for expansion of the District fleet of boats. The *Montana* which had served the District for 14 years was condemned at the end of the 1878 season, and her machinery transferred to a new hull at the D.S. Barmore shipyards at Jefferson, Indiana. The new snagboat which this produced, the *General Barnard*, became part of a growing fleet of steamboats owned and operated by, and in many cases designed and built by, the Rock Island District. At its height in 1910 the District fleet made up nearly 20 percent of the total number of steamboats operating on the Upper Mississippi.

Under Farquhar's direction, engineers in the District began to develop improved equipment. The old chisel boats with their ponderous machinery had never been very efficient, being able to break an average of only 10 cubic yards of rock per day. In September of 1878 Farquhar designed and built a new steam drill scow for subaqueous blasting, hoping to improve on the performance of the chisel boats. The steam drill was built on a decked flatboat furnished with three spuds, and head and side lines. On this deck was placed an upright boiler 57 by 42 inches, which was used to power a 4-inch Ingersoll drill. The drill was attached to the boat's cross head, and hinged so that it could be inclined at any angle.

In October the new steam drill and an old chisel boat were towed up to the Moline Chain on the Rock Island Rapids and tested side by side for 45 days. The steam drill and blasting operation broke an average of 17 cubic yards of rock per day, seven more than the chisel boat. The chisel boat had cost $4,500 to build, while the steam drill boat had cost only $1,800.

Shortly after Mackenzie's arrival to replace Farquhar, District operations were expanded in a new direction with the construction of a Government dry dock at the Des Moines Rapids Canal. The Des Moines Rapids Canal Dry Dock and Canal Shops was the idea of Montgomery Meigs, whose first love was boats. Meigs was responsible for the idea, design, construction, and operation of these facilities, which were built alongside the canal.

Meigs convinced Mackenzie to submit the dry dock project to the Chief of Engineers in 1882. Such a repair facility was badly needed; no other dry dock existed anywhere on the Upper Mississippi. Whenever a boat of the growing District fleet needed repair or re-building, it had to be dragged onto ways on shore. The project was approved in February 1883, and by April Meigs was supervising construction. The dry dock was built at a cost of $133,000 (under five separate appropriations) and finished in 1889. As had been the case with the last few years of construction on the Canal itself, the work was done by hired labor. Meigs never approved of contract work and was always handy with statistics to show how much more cheaply the Corps could do its own work.

The dry dock was situated on a piece of low ground on the river side of the canal embankment just above the middle lock. It furnished a basin 400 feet long and 100 feet wide, with entrance from the canal through gates giving an 80-foot opening. The outer embankment of the dry dock was of clay covered by rip rap. The new canal shops, including machine and storage sheds for boat building and repair, were placed at the lower end of the dock.

The dry dock was filled and emptied by culverts opening into both the river and the canal, and fixed up with closing valves. The inlet was at the head and the outlet was at the foot of the pit. Up to a water stage of about 6 feet above low water, the dry dock could be drained directly into the river; at between a 6- and 12-foot water stage, drainage was into the canal. Stages above 12 feet required the assistance of a 12-inch rotary pump.

The Rock Island District steamboat *Coal Bluff* on the ways at the Des Moines Rapids Canal Dry Dock. Since this was the only dry dock on the Upper Mississippi, the District leased it as needed to private companies for repairs.

Because the Government dry dock was the only one on the Upper Mississippi, the District established a policy that welcomed private boats in for repairs when District boats were not using it. The rates charged ran from $15 per day for boats of under 200 tons to $25 per day for boats over 500 tons.

The dry dock was flooded out in 1913 by the same power dam that submerged the canal. The power company built a new dry dock alongside the new lock near the dam.

With preliminary plans and preparations made, Mackenzie turned to supervise the first concentrated effort at channel improvement using wing dams. The experiments with wing dams at Pig's Eye Island and other locations in 1873 had proved so successful that the *Montana* had spent a part of each season since then in similar work. During the 1879 season, however, work began in earnest. Several thousand feet of wing and closing dams were built at eight locations. Most of this work survived the flood the following spring which brought the highest water ever known to the Upper Mississippi to that date.

Wing dams were not new on the Upper Mississippi. Rivermen had long been pleading for wing dams as a means of improving the channel because of the success lumbermen had with variations of these dams. Often during low water, raftsmen had built crude brush dams held in place by stakes to help wash out a bar, but these in turn washed out with the next high water. A more complicated method of scouring a deep channel was developed by early raftsmen on the Chippewa and Wisconsin Rivers. An assistant engineer, J.D. DuShane, explained this method in an 1895 letter:

> The practice was to separate a raft into strings, then float two strings down to a shoal place, sticking one string on one side of the river and one on the other a sufficient distance apart and in funnel shape, the smaller opening being down stream, thus directing a greater volume of water into the narrow opening and producing a scour at and below the opening; then the other string would be floated down, extending below those first stuck, until a cut through the bar was made. The rafts above would then be sent through in pieces, and the parts stuck on the bar forming the shear [sic.] dams would be separated into cribs, which would be hauled into deeper water and sent through the newly made channel and re-rafted below.[4]

Wing dams had been used on the Ohio and Illinois Rivers to deepen the channels. While these were

The Keokuk and Hamilton Water Power Company Dam and Lock completed in 1913. The pool created by this dam flooded out the Des Moines Rapids and the canal. The old canal lies under fifty feet of fill (foreground) but the dry dock can be seen still operating adjacent to the new lock.

more sturdy than the raftsmen's makeshift dams, they seldom lasted more than several seasons before deteriorating. Later wing dam experiments on the Missouri River proved equally transitory. Only in Europe, on the Danube and the Upper Rhine, had wing dams worked as a lasting improvement. Both of these rivers, like the Mississippi, had shifting, sandy bottoms. Wing dams built in the Rock Island District were almost identical in construction to those of the European rivers.[5]

Wing dams worked by constricting the flow of the river especially in low water, forcing the available water into one narrow channel, increasing the current and volume of water and helping to scour the bottom. In the words of the rivermen, wing dams "stopped the leaks."

Shoal water and sandbars were problems all along the Upper Mississippi, but they provided the most difficulty from La Crosse north to St. Paul. From the mouth of the Wisconsin River to the Rock Island Rapids, the 1878 survey showed only 25 bars; between Keokuk and the mouth of the Illinois River there were only 38 bars; but in the short stretch between St. Paul and the mouth of the St. Croix, the worst part of the river, nearly every one of the 25 crossings had shoal water of three feet or less. Along this 28.7 miles of river there were 29 bad sandbars. The whole section from Read's Landing (at the foot of Lake Pepin) to La Crosse was clogged with sand from the Chippewa River and contained 46 bars needing improvement. During many seasons the upper limit of navigation in low water had been La Crosse or Winona.

Wing dams worked by constricting the channel. The natural width of the Upper Mississippi varied from 350 feet to 1,400 feet at the mouth of the Missouri River. The wing dams created a channel that was 1,200 feet wide or less. Each section of the river was constricted to the width necessary to produce 4½ feet of water. The dams were built to 4 feet above the low water mark. During high water, when extra scouring was not needed, extra water flowed over the tops of the dams. During low water, how-

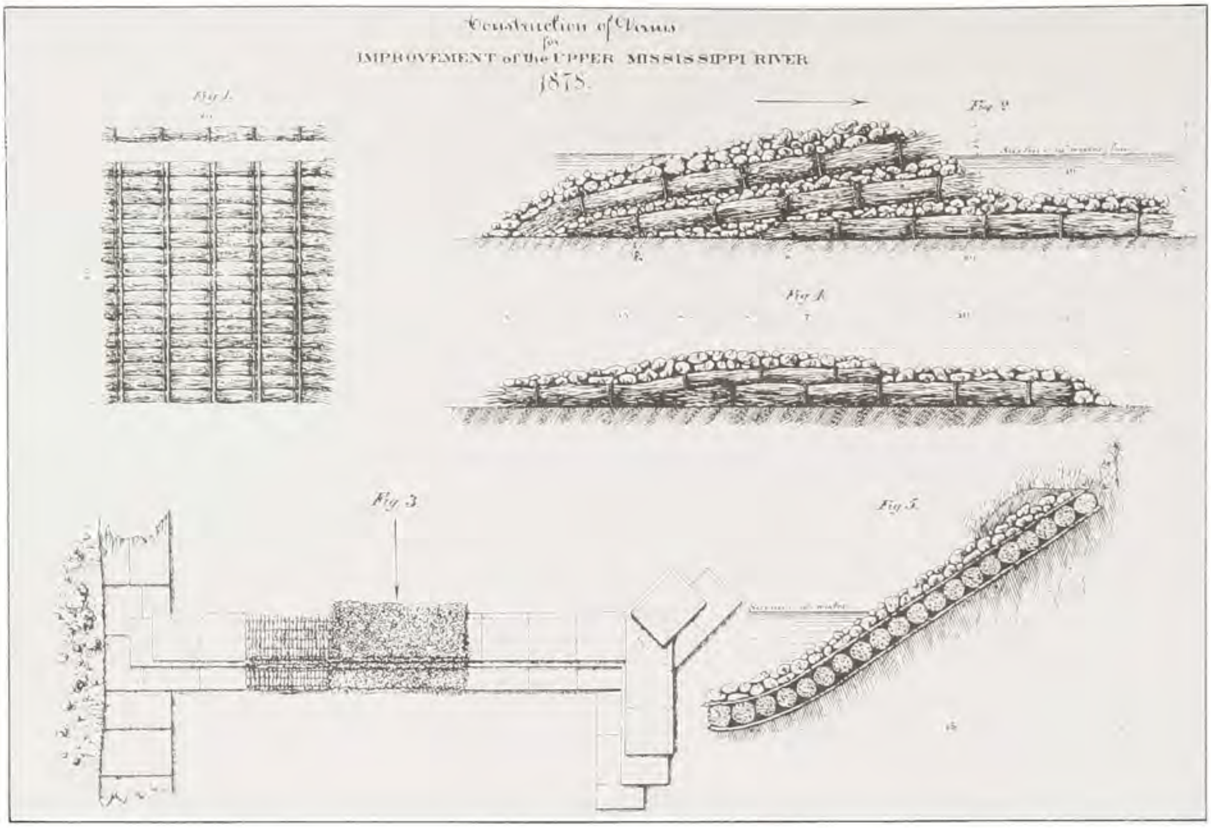
ever, the current was confined to the narrower channel made by the dams. This increased the velocity of the water, causing the current to stir up and carry out of the channel the sand bottom until the new channel had attained the same area cross section as the wider natural channel. Wide and shallow became narrow and deep. When equilibrium was reached in this new deeper channel, the scouring action stopped. Wing dams were also used to aim the current in a given direction so as to wash away an unwanted bar or sand island.

The Rock Island District Engineers never adopted a formal comprehensive plan for the 4½-foot project. Not until 1897 when District Engineer Colonel W.R. King drew up a provisional plan for the project was there anything but a year-to-year operation. In the 1880 *Annual Report* Mackenzie replied to Congressmen who had criticized this lack of planning:

> A general plan with estimates has been prepared, but it is liable to so many alterations of detail due to changes of the river and experience gains as the work progresses, that it is deemed more proper to simply present objects from year to year for the work which can be accomplished with the amounts then available, selecting for improvement the points known to be most troublesome.[7]

Other critics complained that the practice of small annual Congressional appropriations kept the work at a slow pace, but the District was comfortable with this. Moving slowly gave the river herself a chance to participate in the work. The natural scouring of the river could have been hurried by dredging, but it was more economical to let the river do it. In addition, each new wing dam created new water conditions downstream. It took time for these to develop and show what they were going to do. Only then could additional improvements be planned.

One interesting discovery made by Engineers as the work of river improvement continued was that not all of the channel obstruction was natural. DuShane, the assistant engineer at the St. Paul Office of the Rock Island District, discovered that in all of the improvements made above Lake Pepin, the bars removed were found to be "largely composed



Sketches of wing dam construction showing the alternate layers of willow mattress and rock tilting upstream. Bank revetment (Fig. 5) was constructed of the same materials. Much of this construction is still solid after more than 100 years.

of sawdust"[8] and other sawmill refuse which had been dumped in the river. Sawdust was found in bars as far south as Winona.

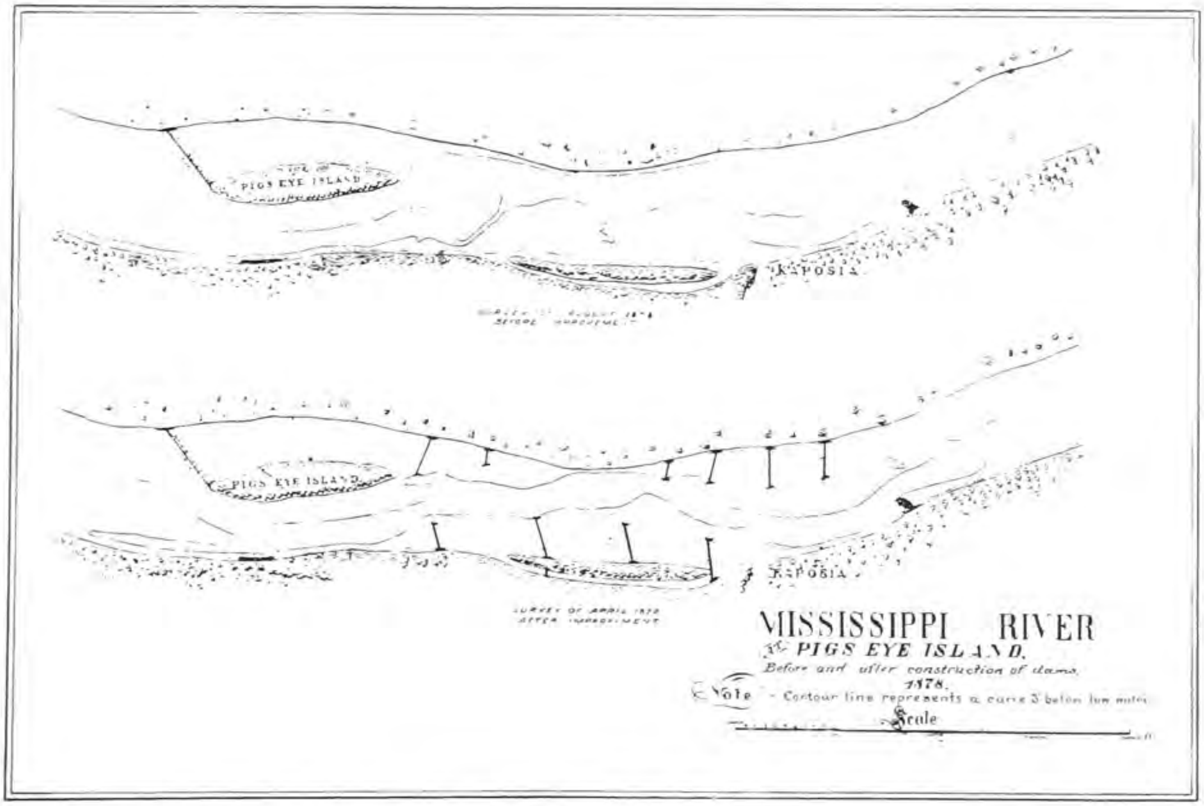
In 1888 the Engineers were called to remove a bar forming near the St. Paul waterfront. Dredging discovered that this bar was formed entirely of garbage dumped into the river by St. Paul. This area of the river had been shoaling for several years; the Corps was called in only when the smell became so objectionable that private citizens obtained an injunction against the governments of both Minneapolis and St. Paul. Minneapolis dumped 500 tons of garbage a day just below the Falls of St. Anthony, and St. Paul added even more than that.

Wing dams proved to be an exceptionally economical method of river improvement. They were generally made of willow mats and crushed stone, both readily available along the whole Upper Mississippi Valley. Crews were able to lay several hundred feet of dam per day.

The first wing dams on the Upper Mississippi were built by the Corps fleet and personnel using hired labor, but after these early experiments developed the correct design, most of the rest were built by contractors. This would not have been possible without adoption of the 4½-foot channel project and the assurance it gave contractors that there would be enough future work to pay for building the equipment necessary to construct the dams. A wing dam fleet consisted of a steamboat, enough quarterboats for the crews as they moved up and down the river, and a variety of barges to haul stone and willow and on which to make the brush mats.

The extensive line of wing dams on the Upper Mississippi provided work for many small contractors rather than one or two large firms, as had been the case with previous improvements such as the Des Moines Rapids Canal. Some of the larger local contractors could and did make a business of Government work between 1878 and 1915, building wing dams up and down the river, but there was

The first experiments with wing and closing dams on the Upper Mississippi were carried out at Pig's Eye Island below St. Paul. The before and after sketches show the channel improvement resulting from the dams.



Willow mattresses were first placed into position along the dam, then sunk with a layer of rock. Rock had to be unloaded evenly to avoid tipping.

room too for the small contractor with a boat and a crew to build a dam or two in his immediate area. Even for the very smallest contractors — a single individual — there was "winter work" to be contracted for. This consisted of repair work: holes in wing dams, breaks in closing dams and shore protections. Such repairs were hard to make in the summer when the river was high.

Each step of wing dam construction involved hard labor, as seen in these photographs of work in the St. Paul area. Rock (up to six inches in diameter) had to be loaded on barges by hand; thousands of twelve-foot lengths of willow had to be tied in small bundles and then woven into mattresses.
—Minnesota Historical Society

Bids for all of these jobs were advertised not only in the city papers at La Crosse and Winona, but in the small weeklies in the river villages such as Genoa, Stoddard, and Brownsville. In this way, nearly all of the money spent by the Government on the 4½-foot channel project went into the local economy through the pockets of numerous small contractors. This was one of the reasons why the Corps of Engineers in the Rock Island District was so well received and even well liked. The Corps

seldom appeared here as it has in other places as an impersonal outside giant imposing its will on a region.

The contracting firm which held the record for the amount of wing dam construction was the partnership of Albert Kirchner and Jacob Richtman of Fountain City, Wisconsin. These men obtained their first contract in 1878 just after the 4½-foot channel project was adopted. When World War I put an end to all appropriations in 1917, Kirchner was still operating as sole owner of the company.

Kirchner and Richtman assembled a fleet consisting of a steamboat (or rather, a succesion of them, including such boats as the *Percy Swain*, long a well-known excursion boat between La Crosse and Alma, Wisconsin), three quarterboats, two buildingboats, a light launch and 18 barges. A commissary boat selling soap, tobacco, and other sundries serviced this floating village.

Large barges about 100 feet long, 20 feet wide and 5 feet from deck to bottom hauled the broken rock and willow bundles (known as brush). Two small 30-foot barges called hoppers were used in weaving the willow into mats for the dams. The buildingboats were the largest of all. They were equipped with boilers and engines, steam and hand capstans. Their purpose was to hold the course along which the dam was to be built. They could propel themselves with lines anchored on shore and out in the river, and could pull barges of material into position.

Contracts for wing dams were usually let by the Rock Island District in the late fall or early winter, the work to be done the following summer.[9] The contractor agreed to furnish "all boats, material, machinery, tools and other appliances necessary to do the work"[10] at points specified by the Corps.

Material for the wing dams consisted of alternate layers of willow mat and crushed or broken stone. By terms of the Government contract the willow had to be recently cut, and trimmed so that the

poles could be gathered into tight bundles or fascines 20 feet long and from 12 to 15 inches in diameter, tied with lath yarn or wire at 4-foot intervals.

These bundles were laid side by side on the hopper barge and lashed together by three or more willow poles on top and bottom (see illustration) to form a mat 12 feet long. The completed mat was pushed off the hopper, floated into position on the wing dam, and then sunk with rock from the stone barges.

Rock was obtained from the bluffs along the river, where it was as plentiful as the willow was in the bottoms. Some of the rock came from private sources and some from Government quarries that were opened and closed as the work progressed along the river. The rock had to meet a specification of 6 inches, cubed, or its equivalent, but not larger than 10 inches. Two-wheeled, one-horse carts brought the rock from the quarries to the barges. Rock had to be loaded uniformly on the barges to keep the barge level and so that Government inspectors could measure and mark down the amount of rock used. Thirty men worked on the stone barges, tossing rock off onto the willow mats.

A wing dam went up quickly. The bottom layer of brush was covered with rock from 6 inches thick at the upriver side to 18 inches on the downriver side. A second layer of brush was laid on this rock 10 or 15 feet further upstream than the lower layer, and covered with rock in the same proportions as the lower layer had been. Additional layers of brush were laid and covered with rock as needed to make the correct height, with each new layer placed an additional 2 feet upstream. The finished dam was high enough (generally 4 feet above low water) so that its top was above water except when the river was high.

Wing dams were serviceable and did what they were designed to do, but the long lines of rock and brush above water for much of the season were admittedly not beautiful. In 1914 a Mr. W.F. Daubenberger at McGregor, Iowa, complained to William

A row of wing dams during low water. Wing dams worked by forcing the current into a constricted main channel during low water, helping to scour the channel to a proper depth. The dams were submerged during high water, and did not impede the current.

Thompson, assistant engineer stationed at La Crosse:

> With the automobile in such common use, people by the hundreds, within a radius of fifty miles, come in to spend a day or week on the river. Then they look across and see a pile of rocks sticking out of the water that makes then think the armies of Europe were using it for a cemetery and were burying their dead there.[11]

It would still be some years, however, before the Rock Island District began to take tourism into account.

An improvement work as important as the wing dam was bank protection, or revetment. At the shore end of the wing dam, revetment was necessary to prevent the current from washing the shore away and rendering the dam useless. The completed wing dam would often deflect the current toward the opposite shore. Bank protection was needed at those places, too. Even straight sections of shoreline were often subject to wearing, and needed revetment.

Although most of the improvement in the $4\frac{1}{2}$-foot project consisted of wing dams, closing dams

similar to that built at the head of Pig's Eye Island in 1873 were also built. By closing off chutes, by-channels, and sloughs, closing dams helped direct the current into the main channel. Closing dams were far more dangerous to build than wing dams because of the currents produced by shutting off an entire channel.[12]

The decision where to place wing dams was made by District engineers who surveyed out the line of each dam prior to the beginning of contract work. Wing dams were generally spaced 5/7 of the channel width apart. Where the river curved, dams were placed one-half a channel width apart on the concave side and full channel width apart on the convex side. The line of the dam pointed very slightly upstream 105 to 110 degrees in straight reaches, 100 to 102½ degrees in concave reaches, and from 90 to 100 degrees where the curve was convex. Dams on opposite sides of the river were arranged so that their axes met in mid-channel.

By 1895 when Mackenzie left the Rock Island District, 100 miles of wing dams and 94 miles of shore protection had been built on the Upper Mississippi at a cost of $5,850,562. By 1895 most of the channel was navigable at low water.

Willow mats were used in the construction of wing dams until 1911. By then it was clear that the supply of available willow was giving out and not replacing itself as rapidly as it was being used up. The Rock Island District had anticipated this and had experimented with willow nurseries and reforesting sandbars with willow cuttings as early as 1881, but the annual floods and rapid currents prevented these from working out well. In 1911 successful experiments were made using lumber mats instead of willow. Any handy wood was used: maple, elm, oak, ash, cottonwood, and pine.[13]

Lumber mats were tried out on the section of the river between the Wisconsin River and Le Claire. Following successful experiments here they were used in the lower divisions of the District between Hannibal, Missouri, and the Missouri River.[14] The

cost of lumber mats compared favorably to willow, but they were not as flexible and did not follow the contour of the river bottom as well. Beginning in 1916 lumber mats were used exclusively for the remaining wing dam construction.

The Rock Island District also made several experiments with sand dams with some success. In 1896-97, 18 sand dams were built, a few of these entirely of sand but most of sand covered by a layer of brush and weighted down with rock. Sand for the dams was taken from the channel by the District suction dredge *Geyser*, and laid along the dam line beginning with the shore. Rock and willow barges on each side of the dam then covered the sand over. On one or two of these the District experimented with placing the willow bundles upright in hopes that the easily-rooted willow would sprout and grow, but this did not work.[15]

Both the willow and the sand wing dams proved to be amazingly permanent. They were often damaged from the ice and by passing boats, but they did not deteriorate much at all. The willow was submerged in the dams so it did not rot, and even today, after more than 100 years, pieces cut off of some of the willow will still float.

By the time authorization of the 6-foot channel project put an end to the 4½-foot project, a total of 12,323,067 cubic yards of brush had been put into dams and shore protections. Engineers and contractors had built 336.40 miles of wing and closing dams and 197.30 miles of shore protection. Total cost of the 4½-foot project from 1878 to 1905 was just over $11,000,000.[16]

Other District Activities, 1877 to 1906

Although the 4½-foot channel constituted the major activity of the Rock Island District during these years, the Corps also engaged in several other projects related to navigation improvement. The period was marked by growing commerce and industry in the towns along the shore, and complicated by

several major shifts in the patterns of water transportation. It was also a period of increasing responsibility for the Corps of Engineers. In 1890 the Corps was given specific authority to establish and enforce rules and regulations for the use of all navigable streams. From this has grown the Corps' responsibility for the entire inland waterway system.[17] In 1899 the Refuse Act, Section 13 of the Rivers and Harbor Bill, prohibited discharges except from public streets and sewers in liquid form into any navigable water of the United States without a permit from the Corps of Engineers. This Act has been seldom used until the past few years.

The appointment of the Mississippi River Commission in 1879 marked the beginning involvement of the Corps in flood control work, although "navigation improvement" remained the official justification until 1917. Prior to this, all authorized projects in the Rock Island District were limited strictly to navigation improvement. That continued to be the case; with the exception of several levee repair projects in 1894, District activities during this period continued to be concerned with navigation.

Harbors. Harbor improvements in the Rock Island District began as early as 1844 when Engineers had unsuccessfully attempted to improve the Dubuque harbor. Appropriations ran out before the work was completed, and several subsequent attempts met a similar fate. Finally, in 1880, Congress appropriated $40,000 for an ice harbor at Dubuque, where boats could winter safe from the effects of the open river. Work was begun in 1882 and completed in 1885. This harbor was used not only by commercial vessels, but as a winter quarters for a large portion of the District fleet.

Other harbor improvements came slowly. The Corps of Engineers had been limited to single-purpose navigation projects, and a fine line divided those improvements which were necessary to commercial river traffic and those which primarily aided city interests or private groups of pleasure boaters. In fact the steamboat companies and the cities themselves had long been in disagreement over

whose responsibility it was to improve harbors and waterfronts. One of the reasons for the steamboats' loss of commercial business during the last half of the 19th century was the lack of good waterfront and terminals for cargo. Steamboatmen wanted the towns to build such facilities while the towns felt the boat companies ought to do it. When the railroads came in and built such terminals themselves, they had an immediate commercial advantage over the boats.

Following the guidelines of "necessary to commercial river traffic," the Corps limited most of its harbor work to dredging sandbars which formed between towns and the main channel, building dams to serve as breakwaters, and deepening the harbors themselves so that larger boats were able to land. Improvements such as harbor enlargements or alterations of shape were left to city or private efforts. By 1911 the District had made major improvements to 22 harbors between St. Paul and Clarksville, Missouri, including most of the larger cities.

In the mid-1880's the Rock Island District designed and constructed two harbors of refuge in Lake Pepin, one at Stockholm, Wisconsin, in 1885, and one at Lake City, Minnesota, in 1887. Lake Pepin is a two- to three-mile wide section of the Mississippi between Red Wing and Read's Landing. There was no problem with currents from boats crossing the nearly slack water of this section, but the open area allowed winds to build up huge waves. These wreaked havoc on the long lumber and log rafts coming downriver from the northern forests. The rafts were frequently split up by such storms and the logs scattered for miles downriver, creating danger for the packetboats. At one time the District snagboat *General Barnard* encountered so many of these free logs that she had to lay up for the season.

The two harbors of refuge constructed by the District were designed to provide boats and rafts with a safe harbor from the sudden storms which frequented Lake Pepin. They consisted of long earth and stone piers built perpendicular to the shore which acted as breakwaters.

Galena River Improvement. Galena, Illinois, was one of the earliest and most ambitious towns on the Upper Mississippi River. Before the Civil War when the lead mines were thriving, more river traffic navigated the Galena River than arrived at St. Paul. But by 1866 increasing cultivation of farmland and a few years of neglect had combined to hasten the natural process of siltation to the point where the Galena River was impossible to navigate in low water and difficult at other times.

A preliminary survey of the Galena River with a view toward improvement was made by Major Farquhar in 1873. Congress authorized an improvement project in 1877, but work did not begin until 1880 when dredging produced a small channel between 35 and 100 feet wide and 4 feet deep, running 5½ miles from the mouth of the river to a point 1½ miles below Galena.

No further appropriations were made. The Galena River project was in that borderline area between a navigable river (which was the Corps' responsibility) and unnavigable rivers (which were under jurisdiction of state or local authorities). There was doubt as to whether an improvement serving one city would constitute "general" navigation improvement.

Congress finally made a compromise. The Act of September 18, 1890, authorized the City of Galena to improve the Galena River from its mouth to a point 800 feet below the Custom House at Galena. Included in the authorization was a dam not more than 12 feet above low water and a lock not less than 280 by 52 feet. The act provided that after keeping the river open to a depth of 3 feet or more for one year, the city would receive $100,000 in Federal funds as partial cost of the improvement.

As a result of this agreement, the Rock Island District assumed control of the Galena Lock and Dam on March 12, 1894. Mackenzie appointed a lock master and two lock hands. Peak traffic through this lock was reached the following year when 471 boats and barges locked through carrying

nearly 5,000 passengers and 2,000 tons of merchandise. By 1896 only 788 passengers on 234 boats passed through the lock. The only significant traffic that year consisted of 1,339,000 board feet of lumber. The Port of Galena proved to be a victim of the railroad that had bridged the Mississippi at Dubuque, just to the north.

Operation of the Galena Lock and Dam was funded under an indefinite annual appropriation beginning in 1898, but less and less traffic used the lock. In 1918 Congress recommended abandonment of the project. Both the lock and channel had reached a point where extensive repairs and dredging would be needed. Finally, the River and Harbor Act of September 22, 1922, directed that the project be abandoned. The District maintained the channel during 1923, though there had been no traffic of record since 1921. The River and Harbor Act of March 3, 1925, directed removal of the dams in the Galena River. Today it is hard to imagine that Galena was ever one of the busy ports on the Upper Mississippi, and that boats of all sizes tied up at her waterfront.

Surveys. Apart from the Galena River survey of 1873 and a preliminary survey for an Illinois-Mississippi canal, the Rock Island District made only two surveys of Mississippi River tributaries during the last quarter of the 19th century. Both were authorized by the River and Harbor Act of August 11, 1882, and were to determine if the rivers involved were navigable and worthy of improvement.

The more important of these surveys was that of the Iowa River from its mouth to Wapello, a city of 1,000 where the Burlington, Cedar Rapids and Northern Rail Road crossed the river. Earlier in the century this and other small tributaries had been frequently navigated. Now, Mackenzie found that small boats still used the Iowa River during the high water season, but that it was not worthy of improvement.

The second survey made in the fall of 1882 was among the most unusual made by the Rock Island

District. This was the survey of the Pecatonica River from Argyle to Wayne, Wisconsin. Since April of 1882 a little steamboat called the *Success*, 50 by 14 feet with a one-foot draft, had been making semi-weekly trips on this stretch. Even though the *Success* was the only steamer ever to have been on this river, its presence made the stream technically navigable. The Pecatonica was so small that the *Success* had to stop periodically to open gates in the fences farmers had strung across it.

Bridges. Railroad and wagon bridges across navigable waters had been the responsibility of the Corps of Engineers since the Act of July 25, 1866. Problems with the Rock Island Bridge in 1856 together with a sudden increase in the number of bridges planned after the Civil War convinced Congress of the need to regulate their construction so as to be fair to both navigation and railroad interests. Congress retained the authority to give or deny permits to build bridges, but the Corps of Engineers was given responsibility for determining the safest location, the spacing and size of the drawspan and raftspan, and later, when high bridges began to take the place of drawspan bridges, for determining the minimum height above high water.

The Act of July 5, 1884, further authorized the Secretary of War to require bridge companies to maintain adequate booms during the navigation season in order to facilitate navigation through the spans. The regulation of these booms became a Corps responsibility.

Booms were usually floating chains of logs or lumber cribs extending upstream from the drawspan piers to protect boats from drifting against the bridge. They were kept in place by anchoring them to pilings or to shore. The sheer booms at the Rock Island Bridge were kept in place by a system of rudders using the river current. Bridge companies had to maintain these booms in the channel until November 15 each year. That was when, by tradition, marine insurance ended, marking the official end of the navigation season.

Occasionally, a bridge proved to be such an obstruction to navigation that Congress ordered it removed or altered. Engineers then had the responsibility to see that those orders were carried out. The Hannibal Railroad Bridge, which had long been a dangerous annoyance to river traffic, was ordered to modify its structure by the River and Harbor Bill of July 5, 1884. After long litigation and delay, the Hannibal Bridge Company changed the location of its drawspan in accordance with the suggestions of District engineers.

The Corps of Engineers retained control over bridges across navigable waters until the mid-1960's, when the Coast Guard was assigned that duty.

Improvements between St. Paul and Minneapolis. Although Rock Island District performed little actual improvement on this short stretch of river, District engineers did much of the early planning for projects later completed by the St. Paul District.

Among the most important of these was repairing and stabilizing the Falls of St. Anthony. The upper crust over which the water flowed at the falls was composed of hard limestone which resisted wearing. Underneath the thin crust was a layer of sandstone all the way down to the river bed. This sandstone layer wore away much more rapidly than the limestone so that after a time the upper layer would lose its support and break off, moving the falls a few feet upstream. Erosion was rapid. By 1872 the falls had moved from 300 to 600 feet above its 1857 location. Left to continue, the falls would eventually be reduced to a long stretch of rapids, destroying not only the beauty of the falls but their waterpower potential, essential to a growing town and an expanding flour milling industry.

In 1872 the Chief of Engineers assigned the improvement of the falls to Macomb, who convened a Board of Engineers to study the problem on August 10, 1872.

The natural wearing of the falls had been hastened in the late 1860's by a private group who

began a tunnel at St. Anthony's Falls designed to run upstream as part of a hydroelectric project. The tunnel through the soft sandstone had reached a point under the foot of Nicolet Island late in 1869 when water entered the tunnel, washing out a large section and causing a cave-in. The tunnel further weakened the falls and the water rushing through the sandstone made the situation precarious.

J.L. Gillespie an assistant engineer of the Rock Island District stationed at the District sub-office in St. Paul, began construction of a wooden apron across Hennepin Island above the falls to divert the water. The apron was in the process of completion when the work was reassigned to the St. Paul District on July 15, 1878.

During the 1891-92 seasons Mackenzie supervised the removal of a number of boulders between St. Paul and Minneapolis. The old head of navigation by act of Congress had been the steamboat landing below the Washington Avenue Bridge at Minneapolis, but now navigating to that point was hard. Two seasons of removing boulders convinced Mackenzie that due to the swift current in this stretch, only a slack water system of locks and dams would bring permanent improvement.

On February 15, 1893, Chief of Engineers Brigadier General Thomas L. Casey ordered Mackenzie to prepare new and exact estimates for locks and dams between Minneapolis and St. Paul. Surveys and borings were made during the low water of 1893 and the plans and estimates drawn up the following winter. Mackenzie reported that to provide navigation to the Washington Avenue Bridge would require two locks and dams: No. 1 just above Minnehaha Creek and No. 2 at Meeker's Island, 1,000 feet below the C.M. and St. Paul Railway Bridge. The cost estimate was slightly over $1,150,000. Mackenzie reported that to obtain navigation all the way to the flour mills at Minneapolis would require two more locks and dams.[18]

Congress authorized Lock and Dam No. 2 in October 1894, and the Engineers made plans to lay the

The Moline Lock under construction. The successful experiments with structural concrete on the Illinois and Mississippi Canal determined that this lock be constructed in the same way.

lock foundation the following spring. However, a private group which owned rights-of-way on Meeker's Island dragged their feet, and by 1897 when the work in this section of the Mississippi was transferred to the St. Paul District, no work had been done. Lock and Dam No. 2 was completed in 1907, but it was drowned out ten years later by Lock and Dam No. 1 just above Minnehaha Creek. This dam, the Minneapolis "high dam" was built to generate electricity as well as to aid navigation. A second Lock and Dam No. 2 was completed at Hastings, Minnesota, in 1930, just prior to the 9-foot channel project.

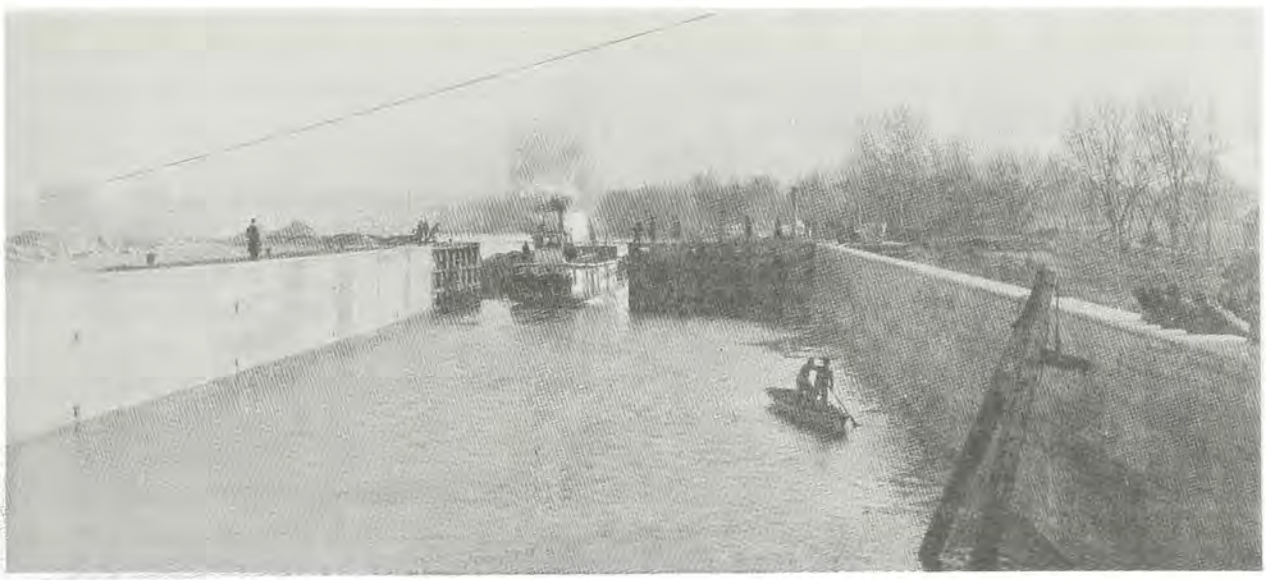
The Moline Lock. Improvements at the Rock Island Rapids had proved satisfactory while the rest of the channel was unimproved, but by 1900 the rest of the Upper Mississippi had been deepened to the point where the rapids again became an obstruction. At the same time, the growing farm equipment industry at Moline needed more adequate steam-

boat access to the Moline waterfront. Docking at Moline was especially hard for upstream boats. The Moline and Duck Creek chains had steeper slopes and swifter currents than anywhere else on the rapids, and boats had to cross both chains to reach Moline.

The River and Harbor bill in 1901 appropriated money for a survey for a lock at Moline and specified that the lock would use the new method of concrete construction which the Corps had developed for the Illinois and Mississippi Canal. The bill failed, but passed in 1902. That year, a Board of Engineers met in October to consider the new lock.

Congress did not authorize construction of the Moline Lock until the River and Harbor Bill of March 3, 1905. Although the Board of Engineers estimated the cost at $386,000 in their 1902 report, Congress appropriated only $100,000 to begin construction, and stipulated that the total cost not exceed $286,000.

Major Charles Riche became District Engineer at Rock Island in April 1905 and supervised the preparation of designs and drawings for the lock. He was well-prepared for this task, having come to Rock Island from the Second Chicago District



The U.S. steam launch *Emily* becomes the first boat to enter the new Moline Lock, begun as one of the final projects on the 4 1/2-foot channel and completed as one of the first on the 6-foot channel.

where he had supervised much of the construction of the Illinois and Mississippi Canal and had become familiar with the concrete construction techniques that had replaced stone construction on that project. In designing the Moline Lock, Riche relied on the advice of Meigs and other assistant engineers in the Rock Island Office. To supervise construction of the lock, Riche had a junior engineer, J.B. Bassett, temporarily transferred from the Northwest Division Office. Mr. Bassett opened a U.S. Engineer Office in Moline. By November 1905 plans were finished.

The Moline Lock project called for dredging a channel 250 feet wide with a 4-foot low water depth from Moline to the head of the Arsenal dike above the city, and a similar channel from Moline to the main channel by means of a lock and dam at the foot of Benham's Island opposite the city. The Moline Lock project was designed to improve 3 miles of the 14-mile Rock Island Rapids.

Bids were advertised and on March 31, 1906, a contract was signed with the Dravo Construction Company of Pittsburgh, to be completed on or before April 1, 1908. The lock chamber was to be 325 by 80 feet. Original authorization called for a 4-foot channel depth with 5 feet in the lock chamber, but in September of 1905, anticipating the coming 6-foot channel project, the depth was increased to 6 feet. The lock was to have concrete walls and wooden gates, operated by electricity. The dam and all back fill were to be built by the Corps using hired labor.

Work went smoothly on all aspects of construction, aside from a stray shot now and then from the Arsenal test range nearby. Though not completely finished, the Moline Lock opened for traffic on December 23, 1907. In January 1908 the Rock Island District officially accepted the lock from the contractor.

Most of the lock usage during 1908 came from District boats transporting supplies. In the spring of 1909 the ferry steamer *B.B.* began using the lock

for service between Moline and Bettendorf, Iowa, and by May the lockmaster recorded 612 lockages with 17,308 passengers. Only three months later, in August, the Moline Lock recorded its peak use: 1,140 lockages with 18,998 passengers, but a commercial freight of only 182 tons. The Moline Lock suffered from bad timing, being finished just as a long decline in river traffic set in. It did have one year of glory, however. The lockages in June, July, and August of 1909 each surpassed the total so far for any single month of the famous Soo Locks. In fact, these three months probably set a record greater than any lock in the world up to that time.[19]

Notes

Chapter 4

1. E.W. Gould, *Fifty Years on the Mississippi: or Gould's History of River Navigation* (St. Louis: Nixon-Jones Printing Co., 1889), p. 300.

2. *Official Report of the Proceedings of the Mississippi River Improvement Convention Held at St. Louis, Mo., 1881* (St. Louis: Great Western Printing Company, 1881), p. 107.

3. Material here and on the next three pages is from the *Annual Reports* of 1878-79.

4. J.D. DuShane to Col. W.R. King, August 22, 1895, File 1653, Vol. 43, Press Copies of Letters Sent ("General Letter Books"), RG77, NA.

5. *Annual Report*, 1875, II, pp. 455-67.

6. *Annual Report*, 1876, Appendix T, p. 6.

7. *Annual Report*, 1880, II, p. 1493.

8. *Annual Report*, 1881, II, p. 1679.

9. Alberta Hill, "Out with the Fleet on the Upper Mississippi, 1898-1917," *Minnesota History* (September 1961), p. 285.

10. *Ibid.*

11. W.F. Daubenberger to William Thompson, November 21, 1914, Old Rock Island Files, RG77, Kansas City Federal Records Center.

12. Hill, p. 287.

13. "K" to Col. Walter Fisk, President, Mississippi River Commission, Old Rock Island File, RG77, KCFRC.

14. Samuel Edwards and Robert Iakisch, "Uses of Plank or Lumber Apron for Shore Protection on the Upper Mississippi River between the Wisconsin River and Le Claire, Iowa," *Professional Memoirs*, VII (1916), p. 390.

15. "K" to Col. Fisk.

16. C.W. Durham, "Project and Estimate for Slack Water Navigation, 6' at Low Water, from St. Paul to Missouri River," Rock Island, Illinois, June 27, 1906. Rock Island District Historical Files.

17. Frank Smith, *The Politics of Conservation* (New York: Pantheon Books, 1966), p. 80.

18. Colonel Alexander Mackenzie to Chief of Engineers, March 1, 1894, File 1652, Vol. 3, Press Copies of Letters Sent ("General Letter Books"), RG77, NA.

19. *Annual Report*, 1909, II, p. 1636.

Chapter 5

The Illinois and Mississippi Canal

Interstate 80 enters Illinois from the east just below Chicago, moves west through a shallow valley in the rolling northern Illinois prairie, and crosses the Mississippi River to Iowa at Rock Island. A careful observer might occasionally notice a railroad track paralleling and crossing his route. At midpoint across the state he might be puzzled by a narrow band of water alongside the highway, with banks too straight to be natural; but unless he were a student of Illinois history, he would not be aware of what an important historic trail his car was following.

The railroad tracks, most recently used by the Rock Island Line, were laid down in the 1850's by the Chicago, Rock Island, and Pacific Railroad. In 1856 these tracks became the first to cross the Mississippi River, and bring serious competition to the steamboat trade. The narrow band of water is the Illinois and Mississippi Canal, conceived even earlier, an outgrowth of the Canal Era of early 19th century America. It was not built, however, until much later, at the end of the 19th century, as a

transportation route from the Mississippi to the Illinois River, and from there to the Great Lakes and the markets of the East.

Along this Illinois valley, then, lies a visual history of transportation in America: a representative of the age of waterway improvement, of the age of the railroad, and finally, of the age of the automobile and truck — all attempts to provide easy interchange between the East and the West for passengers, grain, raw materials and manufactures.

The lines followed by these three transportation routes also show who got there first. The railroad lies along the most level land of all at the bottom of the valley, connecting a string of small prairie farming communities. Roughly parallel to the railroad but on slightly more uneven land lies the canal, a seventy-five mile waterway from the Great Bend of the Illinois River just above the town of Hennepin west to the mouth of the Rock River at the Mississippi. Interstate 80, arriving last, had to be content with hillside.

Of all three, the story of the Illinois and Mississippi Canal is the longest and most complicated. It is a history of both Illinois and national politics, of settlement patterns, of water and rail rivalries and changing transportation needs, and of the Corps of Engineers' relation to all of these.

The idea of an Illinois-Mississippi canal goes as far back as 1673, to Marquette and Joliet's explorations of the western shore of Lake Michigan. Joliet noted the advantages of a connection between Lake Michigan and the Mississippi and concluded that "there will be but one canal to make, and that by cutting only one half-league of prairie from the lake of the Illinois [Michigan] into the St. Louis [Illinois] River which empties into the Mississippi."[1]

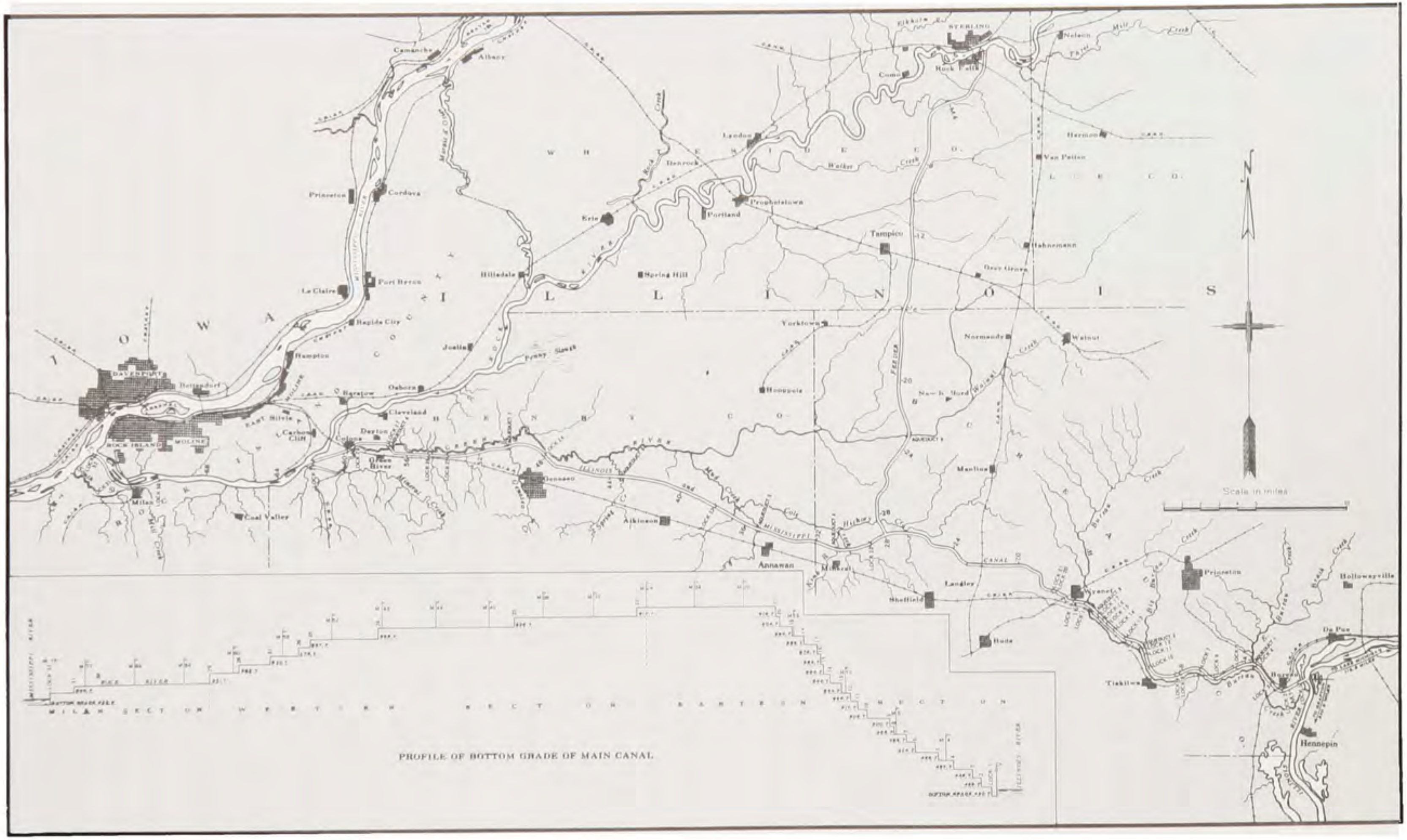
The explorer La Salle also pointed out the advantages of such a canal, and a hundred years later, in 1705, the French talked the Indians in the area into ceding the necessary land between Lake Michigan and the Illinois River.[2]

Following the Louisiana Purchase in 1803, Americans, too, became interested in improving on nature. Stephen Long suggested linking the two bodies of water while exploring western territories for the Topographical Bureau.

Little focused interest or planning was done, however, until the Erie Canal from Albany to Buffalo, New York, opened. Begun in 1817, it had begun to pay for itself in tow fees even before the entire 363 miles was completed in 1825. It brought tremendous growth to the cities along its path. The success of the Erie spawned a Canal Era in American history that saw more than 4,000 miles of canal built or planned in the United States. This boom was partly responsible for the State of Illinois' decision in 1834 to construct the Illinois and Michigan Canal connecting Chicago on Lake Michigan with the Illinois River at La Salle-Peru. When it was completed in 1848 after a number of starts and stops, the promise of its completion had already doubled the size of Chicago — to 20,000 in three years,[3] and was making Chicago a serious rival to St. Louis as a Midwestern transportation center.

The Illinois and Michigan Canal sent traffic down the Illinois River, but many residents of northern Illinois saw a canal extension west to the Mississippi at or near Rock Island as a natural second step. Goods traveling from Rock Island to Chicago via the Mississippi and Illinois Rivers had to travel 607 miles. By canal across the state would be 188 miles, a saving of 419 miles. Such a canal would give the growing towns of Davenport, Rock Island, Dubuque, and Burlington, Iowa, a commercial advantage.

The vagaries of both Illinois and Federal politics and economics frustrated attempts at such an extension until near the end of the 19th century. The Illinois and Mississippi Canal, when it was finally authorized by Congress in 1890, came too little and too late. The vision behind it was still that of the old Canal Era of the 1830's; it was not designed for modern traffic. What traffic there was had already gone elsewhere — to the railroads. When the Illinois and Mississippi Canal finally opened to traffic in


STERLING
Rock Falls
Como
Nelson
Harmon
Van Petten
Lyndon
Denrock
Prophetstown
Portland
Erie
Tampico
Hahnemann
Hillsdale
Spring Hill
Camanche
Albany
Princeton
Cordova
Le Claire
Port Byron
Rapids City
Hampton
DAVENPORT
Bettendorf
ROCK ISLAND
MOLINE
East Moline
Barstow
Osborn
Cleveland
Carbon Cliff
Colona
Green River
Geneseo
Milan
Coal Valley
Atkinson
Annawan
Mineral
Sheffield
Langley
Wyanet
Princeton
Bureau
Tiskilwa
Hennepin
De Pue
Hollowayville
Yorktown
Normandy
Walnut
Hooppole
Manlius
Bude
I O W A
I L L I N O I S
Scale in miles
PROFILE OF BOTTOM GRADE OF MAIN CANAL

1908, even river traffic on the Mississippi was experiencing a decline. The canal was suggested long before it could have been built, and built after it was no longer really needed — one of the first canals proposed in America and one of the last ones built.

The Illinois and Mississippi Canal, its commercial traffic down to less than 500 tons per year, was closed in 1951. After years of negotiations between the Federal government and the State of Illinois, it was made into a state park in 1970. It is now operated by the Illinois Department of Conservation as the Hennepin Canal State Parkway.

Map of the 67-mile Illinois and Mississippi Canal connecting the Illinois River at Bureau with the Mississippi River at Rock Island. For shippers between St. Paul and Rock Island, the canal saved 419 miles over the previous route to the Great Lakes via the Illinois River, but it was completed just as a decline in river traffic set in, and its use never came close to expectations.

On May 22, 1978, the canal was entered in the National Register of Historic Places, a tribute to its long and important history. It remains today as the most complete canal system remaining of all the canals built during the Canal Era of American transportation.

Early Surveys and Plans. Formal proposals for a canal from the Illinois River to the Mississippi began as early as 1832, when a group of local residents gathered by Dr. Augustus G. Langworthy met at Hennepin, Illinois, to call for construction of such a canal. This may have been the same meeting reported as taking place in 1834 by Joseph Galer, a new Illinois settler and former construction superintendent on the Erie Canal. Galer reported that he took his

> blanket and gun and viewed the country through from Hennepin to the Mississippi River near Rock Island and thought it a natural pass for a canal as there was a depression all the way across with high land on either side. I reported my discovery but was much ridiculed for holding such ideas.[4]

Galer reported that he convinced Dr. Langworthy, who owned land near Tiskilwa on the proposed route, that there "might be dollars and cents in it."[5] The group organized by Dr. Langworthy printed circulars and lobbied the Illinois General Assembly for state financing, but any potential interest was cut short by the Panic of 1837. Little more was done until the Civil War renewed fears of the stranglehold the Southern ports had over goods moving on the Mississippi.

The Langworthy meeting turned out to be the first of a series of larger and larger "canal conventions" meeting at various locations in Illinois and Iowa for the next 50 years. Settlers in northern Illinois had come primarily from New England, there were increasing numbers of them after the Civil War, and they naturally looked to the East as their market as well as for their roots. A convention at Davenport, Iowa, in 1864 convinced the General Assembly of Iowa to petition for a canal. Similar conventions in Geneseo, Illinois, in 1866, and at Rock Island in 1874 (attended by 900 representatives) and in 1879 culminated in a seven-state convention at Davenport in 1881. Here 400 representatives of farm, commercial, and local government groups authorized a Hennepin Canal Commission. Representatives of this commission met with Chicago groups to stir interest in a canal, and they also secured passage of a resolution in the Illinois General Assembly calling for Federal construction of the canal. Two members of the commission who were strong proponents of the canal, Major S.J. Allen of Geneseo, Illinois, and Iowa Congressman John Murphy of Davenport, visited officials in the East to gain support for their cause and to stress the fact that the canal was of national, not merely local, significance.

Allen and Murphy met with most success in New York State. Grain and other Midwestern commodities shipped cheaply down the Mississippi to New Orleans and from there to the East coast ended at the port of Baltimore, a rival to New York City. New York interests saw the Hennepin Canal, with its transportation route to the Great Lakes and the Erie Canal, as restoring their competitive edge.

The first actual survey for an Illinois-Mississippi canal route was made in 1866 by a civil engineer, J.O. Hudnutt, hired by several citizens of Dixon, Illinois. The canal proposed by Hudnutt ran from Hennepin to Watertown on the Mississippi (in the center of the Rock Island Rapids) with a feeder from the Rock River at Dixon. The Hudnutt survey was for a canal 60 feet wide at the waterline, 6 feet deep, with locks 150 by 21 feet. Hudnutt estimated the

total cost at $4,500,000, or about the same as Warren's proposal for the Wisconsin River to Green Bay route a year later, and much less than Wilson's estimate for the Illinois River route.

Residents, politicians, and commercial groups in north-central Illinois, and in the Davenport-Rock Island area realized that neither the Wisconsin River route to the north nor the Illinois River route to the south would benefit them as much as these routes would benefit other areas such as St. Louis and St. Paul. Agitation for a canal route through this mid-area continued. The election of General Grant, a resident of Galena, Illinois, as President in 1868 kept those hopes alive.

In 1870 Congress authorized the first Government survey for an Illinois-Mississippi canal. This survey was made by Graham P. Low under the direction of J.N. Macomb, District Engineer at Rock Island. The route selected by Low followed the Hudnutt survey closely, both on the main line and on the feeder to Dixon. Low's survey was for a "ship canal" 160 feet wide at the waterline and 7 feet deep. The 350-foot by 75-foot locks were intended to correspond with (and compete with) those planned for improvement of the Illinois River. The estimated cost of the canal was $12,479,693.

Low and Macomb also submitted a plan for a more modest "commercial canal" of the same dimensions proposed by Hudnutt, the only difference being composite locks. This cost estimate was $3,899,722.

No action was taken on this report, but in 1872 President Ulysses S. Grant convinced the Senate to appoint a committee to study the advantages of such a canal. The committee reported that the canal would be an excellent regulator of railroad rates, but no further action was taken.

The regulation of rail rates was a constant argument used by proponents of the Hennepin Canal, with some justification. In 1880 coal was shipped from Buffalo and Erie to Chicago by water — 900

miles for 64¢ per ton. This same coal was then loaded on trains and shipped to Rock Island and Dubuque — 150 to 200 miles — for $2.00 per ton. Canal proponents felt that with a canal, the price would drop to 50¢ per ton.[8]

A second Government survey was authorized in 1874 as part of a larger study of transportation routes to the seaboard. Due to lack of time, only the Illinois and Michigan Canal was resurveyed. For an Illinois-Mississippi canal, the lines laid down in 1870 were adopted, from Hennepin to Watertown. The cost estimate, with more modest 170- by 30-foot locks, was $4,541,000.

Not until 1882 did a Hennepin Canal bill actually come before Congress. The House Committee on Railways and Canals reported favorably on a $1,000,000 appropriation for the canal. The Senate Committee on Commerce amended this to $100,000, and the House further reduced the appropriation to $30,000 for a survey of the route as part of a compromise bill.

The Hennepin Canal was having difficulty because many congressmen were reluctant to support what they considered a local project, totally within one state, with Federal funds. There was also opposition from the South and from the Lower Mississippi Valley, especially from St. Louis, all of whom saw the canal as a threat to their own commerce. Finally, the Illinois and Michigan Canal which had once been so successful was now too small (it had been a traffic bottleneck on the Illinois waterway since 1851) and was rapidly deteriorating. Any national importance the Hennepin Canal might have depended, of course, on this access to Lake Michigan.

The Act of August 2, 1882, as finally passed, directed the Secretary of War to survey and locate a canal from the Illinois River at or near Hennepin to a point on the Mississippi River at or above Rock Island where practical or convenient, with a feeder from the main line to a convenient point on the Rock River. Both the canal and feeder were to be not less

than 80 feet wide at the waterline, with locks not less than 170 by 30 feet, with a 7-foot depth throughout. The actual size was to be governed by "the minimum draught of the boats at the most unfavorable stage of the main river." The Act also authorized a survey of the old Illinois and Michigan Canal with a view to enlarging it, a necessary part of the success of the whole system.

These surveys were assigned to Major W.H.H. Benyaurd of the Chicago District, who was aided on the Hennepin Canal part of the survey by an assistant engineer, H.B. Herr. The survey by Herr and Benyaurd followed much the same route from the Illinois River as earlier surveys for the first 18 miles. From here, however, it went much further north than previous routes, through a low marshy area known at the Marais d'Osier (willow marsh) which connected the Rock River with the Mississippi. During periods of high water on the Mississippi, this whole area flooded, allowing steamboats a shortcut between the two rivers. The Marais d'Osier route as surveyed by Benyaurd ended near Albany, Illinois, about 14 miles above the head of the Rock Island Rapids.

Before the survey of the Marais d'Osier route was finished, Rock Island and Moline interests complained about the departure from earlier proposals. Rock Island preferred the earlier outlet at the mouth of the Rock River, while a very vocal group of Moline residents favored Hudnutt's Watertown outlet near Campbell's Island. Along with the Watertown route, the Moline residents suggested a dam across the Mississippi at the foot of the rapids in order to provide water for the channel at Watertown, and also, incidentally, to provide Moline with a better waterfront and additional waterpower. Bowing to these pressures, Benyaurd surveyed all three routes, though owing to the lateness of the season, only the Marais d'Osier was thoroughly surveyed.

In his report of March 31, 1883,[9] Major Benyaurd recommended the Marais d'Osier route. It was the shortest: 64.5 miles, compared to 65.2 for the

Watertown route and 74.5 miles for the Rock Island route. Further, land along the Marais d'Osier route was easier to excavate, more level, with fewer lockages required. The number of accessory works — bridges, stream crossings — would be half of what either the Watertown or Rock Island routes would require.

One of the strongest advantages of the Marais d'Osier route, from Benyaurd's point of view, was the natural basin adjacent to the outlet and outside the main channel of the Mississippi, where steamboats could wait for lockage. Not only was there a basin in the Mississippi, but the first lock at Marais d'Osier was 6½ miles from the river, an additional safe place for any number of waiting boats. Benyaurd proposed to excavate a channel here to 7 feet below low water on the Mississippi. During high water, the entire area would flood, adding even more to the space available to boats waiting to use the lock.

By contrast, the Watertown route left no natural slackwater for boats to tie up: the first lock would be right at the outlet into the river. Because this route ended in the middle of the Rock Island Rapids, a channel would have to be excavated through rock nearly a mile across the river to the Iowa side to the improved 4½-foot channel of the Mississippi. The dam across the Mississippi proposed by the Moline proponents of the Watertown route to raise the level of water on the whole rapids was universally opposed by the rafting industry and other commercial river interests, and also by past Corps policy.

The Rock Island route was somewhat easier to engineer than the Watertown route, but since its first lock, too, was near the river, a pool would have to be dredged to provide space for waiting boats.

In his choice of the Marais d'Osier route, Benyaurd assumed that the primary use of the canal would be by grain shippers to the north and west of the canal. For these users, the rapids south of Watertown would be no problem. Statistics seem-

ed to support Benyaurd's assumption. Wheat production in this area of the Upper Mississippi had grown from an aggregate of 50 million tons in 1849-1860 to 195 million tons in 1860-1870, and to 375 million tons from 1870-1881.[10]

Further surveys for these three canal routes were continued in 1885-86 by Major Thomas Handbury when Benyaurd became ill. Handbury's supplements to the 1883 report, published in the *Annual Report* for 1886, actually considered five routes for the western section of the canal, with the feeder to Dixon and the section east of the summit level remaining the same. Handbury supported Benyaurd's choice of the Marais d'Osier route from both an engineering and economic standpoint. He estimated the cost at $5,811,367. The next least expensive route was to Watertown via Penny's Slough, a new path surveyed by Major Handbury which would utilize a long stretch of natural Rock River channel. The estimate for the original Watertown route along the Green River, surveyed in 1882, was $7,207,649, the most expensive of all.

The two Rock Island routes, via Penny's Slough as surveyed by Major Handbury, and along the Green River as surveyed by Benyaurd, were estimated to cost $6,554,052 and $6,709,536 respectively. The feeder to Dixon on the Rock River, common to all routes, was estimated to cost $1,664,117.

Boards of Engineers in 1886 and again in 1887 met to review Benyaurd's and Handbury's recommendations. Both boards agreed with the choice of the Marais d'Osier route. However, the Secretary of War and Brigadier General John Newton, Chief of Engineers, while agreeing that the Marais d'Osier route was best from an engineering standpoint, felt that Benyaurd was wrong in assuming that the heaviest use of the canal would be from grain shippers going east. They felt instead that much of the traffic would be "western bound heavy freight which, from Rock Island as a terminus of the Canal, would be sent downstream for the supply of numerous towns and cities on the Mississippi banks."[11] For such cargo, and for the coal that was

arriving in larger and larger amounts at Chicago from the coal fields of Pennsylvania and from Chicago to growing Midwest industries, the rapids would be a formidable obstacle, should the canal be upstream. General Newton, perhaps thinking of the Rock Island Arsenal, also noted the military advantages of the Rock Island route, and recommended that this one be chosen.

Continued protests from the Moline group helped keep a canal bill from succeeding in 1887, but the River and Harbor Bill of August 11, 1888, brought the Hennepin Canal one step closer in two ways. First, in order to change the image of the canal as a local project bounded by a single state to a project of national significance, Congress changed the name from the Hennepin Canal to the Illinois and Mississippi Canal. Official correspondence shifted to this new name, and the Corps of Engineers used the name in all subsequent surveys and plans, construction, and operations, but the name "Hennepin Canal" remained its popular name among nearly everyone else. Its present status as the Hennepin Canal Parkway State Park shows that its nickname has outlasted its official name.

A second part of the act authorized the Corps of Engineers to submit detailed plans and estimates of cost, and to locate the route. The proportions authorized by the act were in line with the smallest dimensions of the earlier surveys. The canal was to be 80 feet wide at the waterline, with a depth of not less than 7 feet. The locks were to be 170 by 30 feet.

The work of preparing these plans and drawings was assigned to Captain William L. Marshall, who had replaced Handbury as District Engineer at Chicago on April 1, 1888. Prior to this, Marshall had been in charge of improvements on the Fox and Wisconsin Rivers, where he had become familiar with locks and dams.

Marshall's orders to "locate" the canal line was not clear, but he received clarification from the Secretary of War on October 27, 1888. "Locate" meant the Rock Island route, a decision which finally determined where the canal would enter the Mississippi.

On January 2, 1889, Captain (now Major) Marshall began compiling the results of previous surveys. Based on these early reports, he located the line of the canal generally along the Penny's Slough route surveyed by Handbury in 1885, with a feeder to Dixon. Marshall's assistant engineer, G.A.M. Liljencrantz, was in charge of locating the canal, while Marshall was responsible for all the mechanical design and construction: locks, lock foundations, gates, valves and maneuvering gear. The lock design was similar to those Marshall had seen used on the Fox River by Colonel D.C. Houston. The following year, on June 21, 1890, Marshall published a "Final Report upon Location, Plans, and Estimates of the Illinois and Mississippi Canal" as part of his Annual Report to the Chief of Engineers.

This report, with a cost estimate of $6,925,960, was presented to Congress. Victory for canal proponents came on September 19, 1890, when the River and Harbor Bill authorized the first $500,000 for a canal from Hennepin to Rock Island. The bill followed the dimensions of 1888, stipulating that the canal have a capacity for vessels of at least 280 tons burden. An additional stipulation that was to become important to the canal provided that at the discretion of the Secretary of War, the dimensions of the canal in any part could be enlarged "if in his opinion the cost of said improvement is not thereby increased."[12] The bill also provided for construction of all bridges, lock houses, and other structures necessary to operate the canal.

Construction. Marshall began locating the line in November 1890. He had been joined in March of 1890 by two assistant engineers, L.L. Wheeler and James C. Long, who remained with the canal project throughout its construction. Wheeler was a civil engineer who had worked with the Mississippi River Commission prior to the canal project. He became superintendent of the canal when it opened, and transferred to the Rock Island District along with the canal.

The line of the canal began at the Great Bend of the Illinois River (where the river turned south

One of the many innovations developed by the Engineers for the canal was this twin overhead cableway with orange peel buckets. When a soft, peaty section of the canal known as Cecil's Slough proved impossible for contractors to excavate, this cableway, its two towers riding on rails along opposite banks, did the job.

All of the lock foundations at the canal were constructed by pouring concrete over a wooden grill resting on pilings.

A pile driver driving piles for a lock foundation.

toward St. Louis), 1.75 miles upstream from Hennepin. From here it ran along the valley of Bureau Creek to the summit level 18 miles west. From the summit level it angled north to meet the Rock River at Penny's Slough. The remainder of the canal, except for a 4-mile section around the Rock River Rapids at the Mississippi, ran in or along the channel of the Rock River. The feeder ran from the summit level north to meet the Rock River at Dixon.

On April 28-29, 1891, the Illinois Senate and House by joint resolution ceded to the United States jurisdiction of lands acquired for the right-of-way of the canal.

For construction and supervision purposes, the canal was divided into five sections: eastern, western, feeder, Rock River pool, and Milan. James C. Long had local charge of the eastern section, L.L. Wheeler supervised the Milan, western, and feeder sections, while the Rock Island District supervised the improvement of the Rock River pool. Construction of the Illinois and Mississippi Canal began at the Milan section in 1892 and ended at the head of the feeder section in 1907.

One policy decision made at the beginning of construction created later problems. Perhaps owing to the annual and uncertain nature of Congressional appropriations, Marshall decided to acquire right-of-way for the canal as needed, rather than all at once prior to construction. Under this policy, right-of-way for the Milan section was acquired in 1891-92, for the eastern section between 1893 and 1898, for the western section in 1897, for the feeder section between 1896 and 1901, and for the land taken by Lake Sinnissippi (created by the backup of the Rock River behind the Government dam at Sterling) in 1905-06.

As necessary as such policy may have been, it frustrated both the cost estimates and the construction of the canal. Land values rose rapidly during the 1890's, and even without significant land speculation, the cost of the right-of-way more than doubled from the 1883 survey on which the 1890

estimates were made. Continued litigation also held up construction. Marshall estimated in 1895 that if the entire right-of-way had been obtained at once, the whole project could be finished in two years. Instead, 15 years elapsed between the first shovel of dirt and the first boat in the canal.

Milan Section. The Act of 1890 specified that construction of the Illinois and Mississippi Canal begin with the 4½-mile section around the Rock River Rapids near Milan, Illinois. There were two reasons for this. First, the Milan section was a self-contained unit that could be used by itself as soon as completed, and thus show visible progress on the project. It used water from the Rock River rather than from the feeder. Second, a heavy use was predicted for this section. Rock Island had become a primary coaling station for steamboats on the Mississippi, and the Milan section would provide access to the extensive coal fields of western Illinois in the immediate vicinity of the canal.

The Government work force on the canal itself intended to be one of the heaviest users of this section. Sand and gravel needed for construction of the remainder of the canal were located at Milan, while the rock used for the revetment of the canal banks was to come from excavations on the Rock Island Rapids.[13]

L.L. Wheeler established an Engineer Office at Milan in order to supervise final plans and construction of the Milan section. It soon became clear that the original route of the canal around the rapids via the north shore of the Rock River would be difficult. Dams would have to be built across all arms of the Rock River in order to provide enough water, and the discharge rate of the river turned out to be too small to permit the planned wing dams from satisfactorily scouring the upstream channel. The north bank was also heavily settled, with the Sears Water Power Company plant posing a major difficulty.

Wheeler discovered a much easier and more practicable route on the south side of the river. The

Secretary of War approved this new route on March 25, 1891, but an immediate objection was raised by Rock Island citizens who complained that a south route would make railroad and wagon access impossible. A Board of Engineers met in Rock Island on September 7, 1891, to listen to objections, but on September 24, 1891, they recommended Wheeler's southern route.

Another much more important alteration in canal plans prior to construction came early in 1891 when Marshall requested permission to use poured concrete for the lock walls and other structures rather than the traditional cut stone specified in the original plans. Marshall had experimented with concrete construction before coming to the Chicago District when he served as a consulting engineer for a project to protect the lakefront off Chicago's Lincoln Park. Concrete had already seen some use in such construction in France and elsewhere in Europe, and it had been used in the United States for fortifications. Marshall was convinced that concrete would make sound structures.

Marshall pointed out that the stone available in the area — primarily Joliet limestone — was of inferior quality, expensive, and difficult to transport, while "nearly everywhere along the line of the canal is found a good quality of silicious sand and gravel, which, by an admixture of the best quality Portland cement will make an artificial stone which will be as hard as and better resist the action of the elements than the native building stone."[14] It was also, Marshall pointed out in his request, much less expensive — a ratio, he estimated of 10 to 17 in favor of artificial stone. This was an important consideration. The 1890 bill had given the Secretary of War power to change the dimensions of the canal if the expense was not increased. Marshall noted in his request that the use of concrete would save enough money to permit increasing the width of the locks to 35 feet, bringing the canal somewhat more in line with the newer barges and boats being built by the 1890's. Finally, Marshall noted, concrete construction would make "a great experiment in river construction,"[15] which, if successful, could revolutionize the many river improvement projects then in the planning stages.

In order to mix the amounts of concrete needed for the lock walls, Wheeler and Captain Marshall designed this elevated concrete mixer holding five barrels at a time. Carts on tracks carried the concrete to the lock site.

Marshall proposed a secondary experiment in the use of concrete: the use of Portland cement rather than imported European cements commonly used at the time and considered vastly superior to the American product. Marshall was convinced that Portland cement was at least as good as imported cement.

On May 11, 1891, the Secretary of War authorized Marshall to use concrete construction and to increase the canal lock width to 35 feet.

In order to construct the locks of concrete, Marshall and Wheeler had to devise entirely new building methods. The minimal use of concrete that had been done before relied on old-fashioned, slow methods. The usual practice was to pour the concrete into the forms in horizontal layers, letting each layer partially harden overnight before adding another layer. The result, particularly if the layers were not carefully levelled each time, was a layer

cake of separate sections. These "planes of weakness" weakened the whole structure by allowing water to seep in.

Cement was also mixed a barrel at a time. An occasional weak or defective barrel created other soft spots in the structure. Marshall also felt that the traditional practice of finishing or plastering the surface with a thin coat of cement weakened the whole.

While a consulting engineer for the Commissioners of Lincoln Park, Marshall had developed a better method of pouring concrete walls, and he determined to adapt this method to the canal lock walls. First, he constructed the wooden forms for the walls in vertical rather than horizontal sections, and poured the concrete into alternate vertical sections. The filling of each lock wall was done without intermission, using three shifts of workers around the clock where necessary, so that the wall was one

Construction proceeding on the south wall of Lock 36, showing the timber reinforcing forms designed by L. L. Wheeler to hold the poured concrete. The finished north wall shows the end result.

homogeneous mass rather than a layered structure. With 68 men on each shift, an entire lock superstructure could be finished in a week. After a wall had been poured, it was kept wet for three weeks to give additional hardness to the concrete. To insure that no weak barrel could damage a wall, Marshall mixed five to ten barrels of cement together at one time, minimizing the effects of a bad barrel.

The wooden forms for the lock walls were designed by Wheeler to hold up under the tremendous pressure of such masses of concrete. The inside of the forms had to be much smoother than ordinary, since the walls were not surfaced or plastered when the forms were removed.

Special equipment had to be designed to mix the concrete. Previous contractors had mixed each batch by hand or by the use of small mixers. These techniques were employed at the canal post factory to make cement fence and telephone poles, and for other small amounts of concrete; but for the massive amount of concrete needed for the lock walls, Wheeler designed an elevated cement mixing machine. Large amounts of cement could be mixed and poured into cars underneath and taken continuously to the construction site.

The methods and machines devised by Marshall and L.L. Wheeler for the Illinois and Mississippi Canal became standard practice in the industry. Their methods were especially important to the new Panama Canal construction, but they helped revolutionize building practices in the United States, too. *The canal was as important as an experiment as it was for its commercial navigation use.*

Marshall's faith in Portland cement was another experiment that worked out; it helped make the United States less dependent on imported cement. As part of his experiments at the canal site, Marshall did extensive tests of Portland cement, and the grades and specifications he established became standard in the industry.

Meanwhile, Wheeler continued work on the Milan section. By June 1892, plans were complete and contracts had been let for three miles of canal trunk, for three lock foundations, and for sand and gravel. As on the remainder of the canal, most of the actual construction was bid out to private contractors.

The first actual construction of the Milan section began in July 1892 when Wheeler turned over the first spade of dirt. The spade is now in the Historical Society in Davenport.[16]

Construction had no sooner begun when, on August 1, 1892, the new 8-hour work day took effect. Wheeler had submitted contracts to the Secretary of War for approval prior to this, but they did not arrive until after August 1. Wheeler's estimates were based on a 10-hour work day, and these now had to be revised, adding 25% to the cost of labor here and elsewhere on the canal.

Work went smoothly on the Milan section, and it was completed by November 1894. The work consisted of two dams across the arms of the Rock River at the head of the rapids, with seven tainter gates to control the water level; 4½ miles of canal prism, of which about 4,000 feet consisted of embankments in the bed of the river; one guard lock and two lift locks, seven sluices, one culvert, and two metal swing bridges.

Water was turned into the canal on November 29, 1894, and the Milan section opened to navigation at ceremonies led by Wheeler on April 17, 1895. At this ceremony Captain W.C. Clark of Buffalo, Iowa, a steamboatman, noted that the locks were too small for the barges then being built — a prophetic statement.[17]

The Rock Island District completed the Rock River pool section of the canal — essentially a dredging operation — in conjunction with the Milan section from an 1892 appropriation.

Use of the Milan section was temporarily limited to passenger and excursion boats due to three

restrictive bridges — the Moline Wagon Bridge and two railroad bridges — across the canal. These bridges prevented the passage of boats requiring more than 11 feet of headroom.

For the next five or six years, however, the Milan section of the canal was used heavily by both Government plant and local shippers: more use, ironically, than the completed canal would ever receive. Peak years for the Milan section came in 1899-1900, when the locks competed easily with the larger locks recently completed at LaGrange and Kampsville on the Illinois River. During July 1899, for example, when lockages on the Illinois River were below 100, there were 292 lockages through the Milan locks by 84 different steamers and 59 barges, with 713 passengers. October of 1899 saw 454 lockages.[18] In 1901 and 1902, however, the coal fields in western Illinois began closing, victims of competition from better coal elsewhere, and the use of the Milan section declined, still used heavily only for work on the canal itself.

On March 30, 1901, operation and care of the Milan section was transferred from Major Willard (who had replaced Marshall on December 31, 1899) of the Chicago District to Major Curtis McD. Townsend, District Engineer at Rock Island. This transfer was part of a realignment of the Chicago District. On June 24, 1901, much of the work involving Chicago lakes and harbors, and improvement of the Illinois River was assigned to Colonel O.H. Ernst, Division Engineer of the Northwest Division. Major Willard was assigned to a newly created Second Chicago District, consisting of the Illinois and Mississippi Canal and the operation and care of the locks at LaGrange and Kampsville.

Major Willard remained in charge until July 31, 1903, when he was relieved by Major Charles Riche. Riche turned the work over to Major W.H. Bixby on April 20, 1905, after being assigned as District Engineer at Rock Island. On April 30, 1906, Riche again assumed command of the Second Chicago District, while retaining his responsibilities at Rock Island as well. Although Riche maintained a

Chicago office, the work was consolidated from then on at Rock Island, until the Second Chicago District was dissolved on February 18, 1911. On March 31, 1911, the entire Illinois and Mississippi Canal was transferred to the Rock Island District.

Eastern Section. Work on the eastern section of the Illinois and Mississippi Canal, mile 1 to mile 24, began under James C. Long in 1894. From here on through the western and feeder sections, construction procedures remained much the same. The canal prism was constructed first, followed by the locks and other structures. The prism was divided into sections of about four miles, and let out to private contractors in bids covering one mile each.

The prism of the canal was constructed in three ways, depending on the terrain: entirely above the level of the surrounding ground, entirely excavated below ground level, and partially excavated and partially embanked. Where the prism was entirely embanked, the banks were 10 feet wide at the top; where the embankment was partial, the top was 8 feet wide. Those sections of the prism entirely below grade had a tow path 16 feet wide and 2½ feet high along one bank. The slope of all banks on the canal was 1 on 2 inside the prism and 1 on 1½ on the outside.

The feeder line was totally embanked; most of the western section was excavated; while much of the eastern section was partially excavated and partially embanked.

The right of way for the canal was at least 300 feet wide for the entire main line and feeder. At places, however, it was as much as 1,000 feet wide to accommodate turnouts for passing boats every four or five miles along the line, and for the shops and warehouses needed to operate the canal. The canal prism was also wider above and below each lock. The prism of the main line and feeder was 52 feet wide at the bottom and 80 feet wide at the waterline.

Embankments on the eastern section tended to be high due to the rapid drop from the summit level to

Fill was hauled to the embankments by small locomotives carrying dump cars along temporary tracks atop the embankment.

the Illinois River: 196 feet in 18 miles, with 21 locks whose lifts varied from 6 to 12 feet. Because of this, horse-drawn teams had difficulty hauling fill and supplies for the embankments. In order to alleviate the problem, Long had a narrow 3-foot gauge railroad built from mile 2 to mile 17 to carry supplies. Two small engines, the "Davenport" and the "Hennepin," hauled carloads of fill to the embankments in this area. A short section of railroad was also used at mile 24, a peaty area known as Devil's Slough, to bring supplies to the 30 teams and 40 laborers constructing this mile of bank. For this site, Long devised a "movable trestle" from which the train cars dumped material where it was needed.[19]

By 1900 the prism, lock walls and foundations, and most of the other structures (bridge abutments, culverts, etc.) were complete in the eastern section. There was one major exception. Mile 20 through mile 23 crossed a peat bog known as Cecil's Slough where decayed vegetation lay 20 to 50 feet deep,

making both drainage and excavation difficult. Alternate routes for the canal had been considered as early as 1893. A construction contract for these three miles was let with the Globe Construction Company of Cincinnati, Ohio, in 1897, but two years later when their contract expired they abandoned the work only 30% completed. Not only was the peat soft and hard to maintain in the bank, but Pond Creek, which drained Cecil's Slough, crossed the line of the canal several times in three miles, creating drainage problems.

Several alternate routes were again considered, but a Board of Engineers on June 8, 1901, decided to keep the original line. This Board, together with Major Willard, worked out an ingenious solution. They determined to excavate Cecil's Slough by a specially designed cableway. Two wooden towers were constructed and located on each side of the prism, 525 feet apart. The movable towers were 57 feet high, with 45-foot-square bases, resting on 24 pairs of standard gauge car wheels and trucks, which moved on five steel rails along the excavation route.

From the top of each tower was suspended twin main cables 2½ inches in diameter. Two conveyors travelled on these cables, each carrying a 1½-cubic yard orange peel bucket. The conveyors moved back and forth on the main cables by ⅞-inch endless wire cable connected to a drum on the head tower. The buckets were hoisted and lowered by a ¾-inch cable attached to a second drum, and opened and closed by a second ¾-inch cable attached to closing pulleys. With a 125-horsepower steam engine operating each bucket, this "duplex cableway" was capable of making 40 trips per hour. The Cecil's Slough excavation was completed by the Government using this invention and hired labor.

Western Section. The final report of plans for the Illinois and Mississippi Canal submitted to Congress by Marshall in 1890 called for the western section of the canal to head northwest from the summit level to Penny's Slough, and from there down the channel of the Rock River to Milan. To create

enough water for this route, the 1890 plans called for two shallow dams — one of 5 feet and the other 3 feet — across the Rock River above the mouth of the Green River. However, the completed shallow dams at Milan had already caused complaints from the overflow and soaking of low adjacent farmland. There were fears that the new dams would do the same thing, even though they were designed to be thrown down during high water. Other problems appeared with the Penny's Slough route. Even with the dams, a lot of dredging would be necessary. A channel dredged in the riverbed, with undefined banks, would require much more upkeep and would deteriorate much faster than a prism with clearly defined banks. Further, the crossing of the Green River on this route was bad, and the descent to Penny's Slough was so steep that it would have required a flight of locks close together. The alterations of bridges on two major rail lines added an additional problem.

To avoid this difficult route, Wheeler surveyed a new route along the Green River in 1896, a route similar to that surveyed by Major Benyaurd in 1883. The Secretary of War approved this new location on February 1, 1897.

As finally built, the western section of the canal ran from mile 24 at the summit level to mile 62 at the point where the Green River entered the Rock River. Right-of-way for the western section was obtained entirely in 1897 under a new funding status. The River and Harbor Act of June 3, 1896, placed the canal on a "continuing contract" system, limiting to an average of $400,000 the total contract obligations that could be incurred in any given year. The continuing contract system supported canal construction from 1897 to 1902.

The slope of the western section was much gentler than that of the eastern section, and most of it was excavated rather than embanked. Wheeler and the contractors experienced few problems with this section.

Feeder Section. As engineer in charge of the feeder section, Wheeler turned his attention there

Control works and guard lock at the head of the feeder canal near Sterling, Illinois. The Rock River is in the background.

next. In the winter of 1890-91 several residents of the Sterling-Rock Falls area, downstream from Dixon, had written to the Secretary of War suggesting the possibility of moving the head of the feeder from Dixon to Sterling. At their own expense they had made a preliminary examination of their proposed new route, with profiles and estimates.[20]

It was evident that this new feeder line would result in a number of savings. At Dixon, the feeder would have interfered with city streets and created problems for the town's drainage. Moving the feeder to Sterling would also cut 5.7 miles from the length of the feeder. With the feeder at Sterling, the summit level of the canal could be lowered nine feet, permitting three locks to be cut out of the main line, and the lift lock at the dam to be replaced by a guard lock. Transit time across the main line would be cut by one hour.

For these reasons the Secretary of War ordered Wheeler to resurvey the feeder line. As a result of this resurvey, the Sterling route was adopted, and in 1902 Wheeler moved to Sterling and set up an Engineer Office.

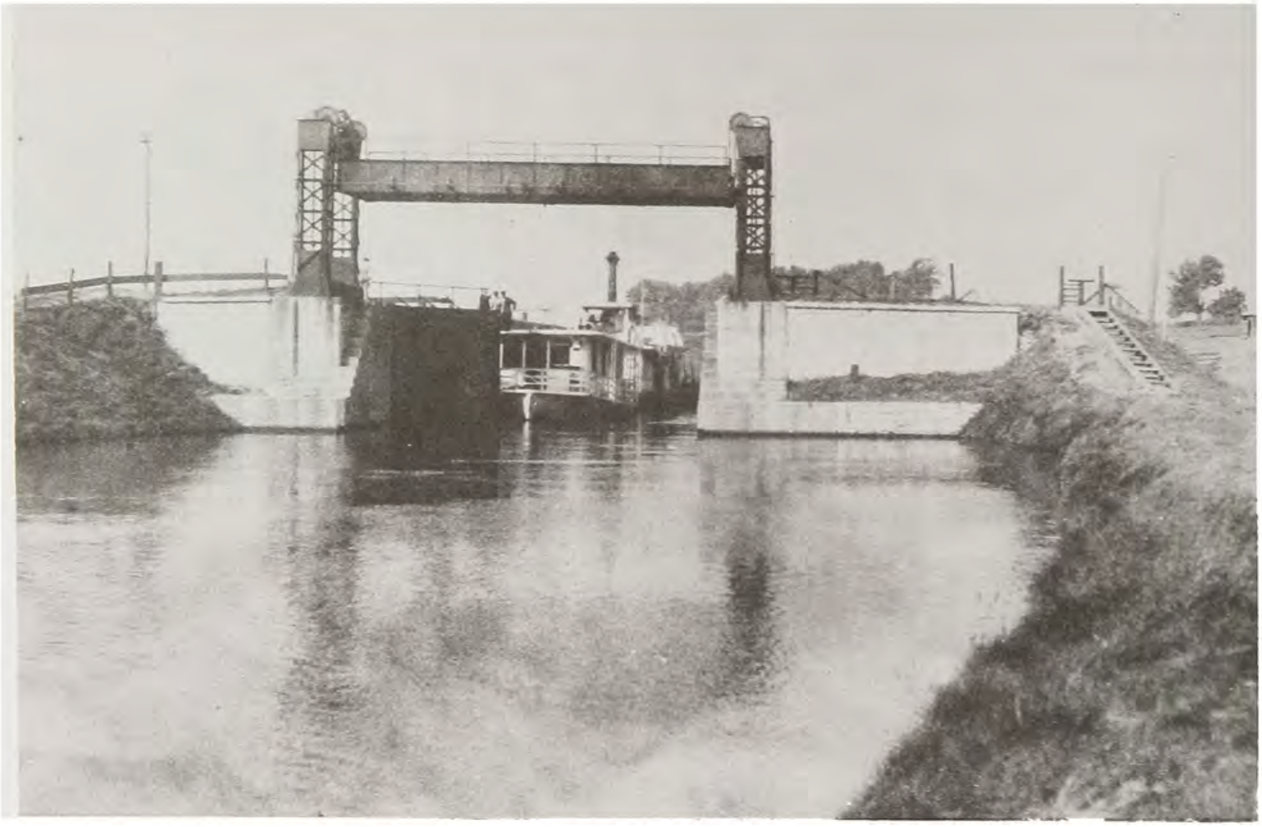
The length of the feeder as finally determined was 29.3 miles, almost all of it embankment. Excavation work was begun in 1899. Here, as at the eastern section, a narrow gauge railroad was used from mile 1 to mile 8 (from the head of the feeder at Sterling) to haul material for the banks. Because the feeder traveled through such level country, it had a fall of only 2.3 feet for the entire length. The feeder met the summit level (mile 17.4 to mile 28.9) at mile 28 just north of Sheffield, Illinois. Because the 40 miles of feeder and summit were all embanked above level and held 100,000,000 cubic feet of water, emergency gates had to be installed to prevent serious flooding of surrounding farmland that might have resulted from a break in the prism. An ordinary mitering gate was placed at mile 23 of the main line. At mile 23.1 of the feeder, at the end of Aqueduct 9 where the feeder crosses the Green River, an emergency gate of the Desfontaines type was placed. This was a buoyant gate moving on a horizontal axis and held down by chains. The guard lock at the head of the feeder protected the canal against sudden surges of water from the Rock River.

In order to provide enough water for the feeder, a dam had to be constructed at Sterling. Both the dam and the canal's need for water created problems between the Government and the Sterling Hydraulic Company. The company had been guaranteed a minimum amount of waterpower from the Rock River by state charter. They objected to the original plans for the dam, and to several subsequent ones, until the Sterling Dam became one of the main obstacles to completion of the canal. Finally, on December 6, 1906, the Sterling Hydraulic Company agreed in writing to accept plans for the dam at the original site. During most of the five years of litigation, Wheeler had been caught in the middle of the fight, and company representatives had refused even to speak to him. No sooner was the

Aqueducts were needed at those places where the canal crossed another stream. This is Aqueduct No. 1.

agreement between the company and the Government concluded, however, when officials of the company approached Major Riche and asked to borrow Wheeler's services to design and supervise construction of their power station. This compliment to Wheeler's abilities as an engineer was indicative of his valuable services on the canal project.[21]

The movable dam at Sterling was rapidly completed. Its manually operated Tainter gates permitted the passage of 40,000 cubic feet of water per minute during high water. During low water, the water level was raised by the use of wooden flashboards inserted by hand. The Sterling Hydraulic Company operated the six gates adjacent to their plant, while canal employees operated the remainder. The Sterling Dam also contained a navigation lock to pass boats up and down the Rock River.



Although most bridges over the canal were stationary, both swing and lift bridges were used at several locations. This is Bridge No. 40 at Lock 26.

A guard lock of the same dimensions as all other locks on the project was placed at the head of the feeder to regulate water flow into the feeder, to serve as an emergency gate for the canal, and to provide boats access to the river.

One other problem during feeder construction came with the 21 highway bridges across the feeder. Area highway commissioners held up completion of the feeder with court litigation over the dimensions of the bridges and the grade of the approaches. In 1906 the courts decided the issue, mostly in favor of the United States, but the litigation did result in a reduction in the clearance of bridges over the feeder from the 17 feet used in the main line of the canal to 12 feet.

The dam at Sterling-Rock Falls created a reservoir for the canal for 16 miles upstream, with a surface area of 2,400 acres. The Government obtained flowage rights for the land inundated by this reser-

voir (known as Lake Sinnissippi) rather than buying the land outright.

Completion of the Project. By 1902 most of the locks were ready for installation of gates and operating machinery. The gates had been left until last because they were made of wood rather than steel, a departure from the original plans in the interest of economy. With no water in the canal to keep the wood wet, the gates would have deteriorated.

There were 33 locks on the canal, 32 on the main line and one at the head of the feeder. With local minor variations, all locks were identical in size and construction. The lock chamber was 170 by 35 feet, with walls 240 feet long and four feet wide. The bottom width of the walls was 45% of the height. Where the lock was built on solid rock, the foundation was levelled with concrete. A majority of locks, however, were built on earth. For these locks, rows of piles were driven into the ground and capped with a grillage of timbers with concrete filling the spaces in between. The floors of all locks were lined with 2-inch pine timbers.

The lower ends of each lock were stepped down and connected to wing walls. For 40 feet above and below each lock, the banks were paved; on the eastern section with rubble and on the western section with concrete.

The lower lock gates of all the locks were wooden miter-type gates angled 70°30' from the center line. Similar miter gates were used for all but 14 of the upper gates. At locks 8 through 21, however, "Marshall automatic gates" were used. These had been designed by Marshall for the Illinois and Mississippi Canal, and have never been used elsewhere.

Marshall had already left the Chicago District before the gates were installed, but Major Willard had an experimental Marshall gate built and installed at Lock 18. A bulkhead was placed at the lower end of the lock chamber and an embankment constructed across the prism 200 feet above the lock, and the

area filled with water. After the gate was operated successfully several times, plans went ahead for their use.

The Marshall gate was a single gate extending from one lock wall to the other. It raised and lowered on a horizontal axis. The middle third of the gate had a rigid wooden leaf extending out at right angles from the gate on the upstream side. The leaf rested in a watertight chamber which was connected to the lower pool by a spillway pipe. The gate was operated by opening a valve in the spillway, permitting water to exert pressure on the leaf. While the water in the pool was lower than the head of water on the upstream side, the pressure of the head of water held the gate shut. But when the two water levels grew nearly equal as the lock chamber filled, the pressure on the leaf pushed the gate down and held it below the sill so that boats could pass in or out of the lock chamber. The gate was then raised by shutting off the water pressure on the leaf and letting the watertight gate rise to a closed position from its own buoyancy.

Today only one Marshall gate, at Lock 16, has been restored to operating condition. The gates caused problems by getting stuck and failing to open and close properly.

All of the gates and valves on the locks were operated manually. The lock was filled by two tunnels, one in each lock wall. A butterfly valve at the head of each tunnel was turned by a hand wheel from the top of each wall. The lock chamber was emptied by butterfly valves controlling openings in the bottom of the lower gates. These valves were operated by levers from the tops of the gates.

Water for the various levels of the canal was carried from the summit level over the upper end of each lock through a spillway to the lower level. The spillways were made of cast iron pipes behind the lock walls. They ranged in size from 48 inches at the summit level to 18 inches at the lower ends of the canal.

In addition to the locks, the canal project involved construction of a number of other structures. The canal crossed significant streams at nine places, necessitating the use of aqueduct bridges to carry the canal across. These aqueducts rested on poured concrete piers above concrete-filled grillage similar to that of the lock beds. The aqueducts themselves were made of reinforced concrete using steel I-beams, and were timber lined, providing a channel of 39 feet, 6 inches.

The many smaller streams and creeks that intersected the canal prism were carried under the canal bed by several forms of inverted siphons. Twenty-six of these crossings were concrete arch culverts; 38 were pipe culverts.

Highway and railroad crossings provided more of a problem than streams. Because the railroads had gotten to the area first, the canal was crossed by four branches of the Chicago, Burlington, and Quincy Railroad, by the main line of the Chicago, Rock Island, and Pacific in two places, once by the Rock Island and Peoria, and once by the Peoria branch of the Chicago and Northwestern, necessitating the construction of eight railroad bridges. In addition, the Corps of Engineers constructed 67 highway bridges across the canal, as well as two pontoon and one farm bridge. The bridges all had 17 feet of clearance over the canal, and were constructed to cross at right angles to the prism, making many of the approaches awkward.

Several kinds of bridges were used to cross the canal. The first bridges were pony Warren truss type superstructures 98 feet long and, as with all the canal bridges, at least 12 feet wide. Several later bridges were through Riverbed Pratt truss type, again 98 feet long. The most common bridge on the main line of the canal was the Pratt truss superstructure with 110-foot spans, 18 feet wide. There were more than 25 of these.

Four highway bridges were movable. Three were through girder lift bridges with 40-foot spans. One, at Lock 2, was a retractable girder bridge with a

54-foot span. This bridge rested on the walls of Lock 2 and retracted to the north bank. On the feeder canal, the majority of bridges were pony Warren truss types with 74-foot spans.

Construction of the Illinois and Mississippi Canal officially ended on October 21, 1907. On October 24, water from the Rock River at Sterling was turned into the feeder. The canal filled slowly. There were fears that the prism, unwatered for up to 13 years of construction, might not hold, but it did.

On November 8, the U.S. steamboat *Marion* became the first boat to enter the canal. With a load of Government officials on board, the *Marion* entered the canal from the Illinois River. It arrived at the Mississippi River on November 15.

L.L. Wheeler was promoted to Superintendent of the Illinois and Mississippi Canal. He opened the canal to commercial traffic in April 1908. The total cost of the canal to that point had been $7,319,563.39. The labor force on the canal had moved 13,700,000 cubic yards of earth and poured 240,000 cubic yards of concrete over a 15-year period.

Operation and Maintenance. While the canal was being built, the employment it provided was a significant economic factor in western Illinois, keeping contractors and a large labor force busy. With the close of construction, this labor force disappeared and was replaced by a smaller but important group of employees necessary to operate and maintain the canal.

To operate the canal, sub-sections varying from 4 to 12 miles in length on both the main line and feeder were placed in charge of 14 overseers. Each overseer was provided with a house on the canal right-of-way, 13 of them built by the Corps of Engineers. Seven of the houses were of a common design; two-story frame, with eight rooms, on a 24-by 30-foot foundation. The other six overseers' houses constructed by the Corps were slightly larger and more elaborate, presumably because these overseers had additional responsibilities. The larger houses occurred at places such as the head of the feeder and at Lock 19, where there were additional shops and warehouses.

Under each overseer were the lockmen at each of the locks, and patrolmen to guard canal property.

These views of the upper and lower gates of Lock 2 show typical lock construction for most of the 32 locks on the main canal and on the lock at the head of the feeder. Fourteen of the locks had submersible upper gates designed by Captain W. L. Marshall, District Engineer in charge of the project.

The Rock Island District boat assigned to operation and maintenance of the canal was the steamer *Marion*. On November 15, 1907, the *Marion* became the first boat to pass the entire line of the canal.

During the summer this work force expanded to handle such maintenance and repair duties as cutting grass, resurfacing the tow path, and repairing banks. The Corps also provided 38 houses for the lockmen and patrolmen. Thirty of these were identical two-story frame, with gambrel roofs and seven rooms, on a 22- by 28-foot foundation. The lockman's house at mile 20 was the same design as the others, but was made entirely of concrete. Each residence was provided with barns and equipment sheds.

The Corps required overseers, lockmen, and patrolmen, whose jobs were year around, to live in these houses, deducting the rent from their salaries. These permanent residents of the "canal community" were encouraged to keep livestock. The technical limit for each household was three cows and their offspring, although several employees kept dairy or beef herds up to 30 head. The cattle grazed free on the canal right-of-way, which helped keep the grass and weeds down. Some families also kept chickens, pigs, and horses.[22]

Other buildings on canal property included warehouses at several locations, blacksmith shops, ice houses, repair shops and office buildings. Concentrations of these service buildings stood at the end of the feeder, at Lock 19, and at mile 26. In addition, a boat ways at mile 17.7 on the summit level provided a place where boats could be taken out of the canal for repairs; and a boatyard known as the Silver Lake Boatyard at the Milan section housed the Government fleet during the winter.

Because of the common privileges the canal employees shared, but also because of their common liabilities—especially not being able to be part of a more regular settled community—the canal employees formed a small world of their own, linked loosely together by similarity of occupation and interest. These Corps employees and the hands who worked on the boats and barges formed a social unit "typical of canal life on all American canals."[23]

The small steamer *Mary Mac* pushing a barge of lumber past Mile 2 on the feeder shortly after the canal opened to traffic.

The opening of the Illinois and Mississippi Canal to traffic in 1908 brought attention once again to the navigation limitations at both ends of the canal:

the Upper Mississippi River's 4½-foot channel and the antiquated Illinois and Michigan Canal. While the Illinois and Mississippi Canal was capable of passing boats 140 feet long with a 34-foot beam and 640 gross tons displacement, the Illinois and Michigan Canal could accommodate boats no longer than 108 feet by 17 feet, drawing a maximum of 4½ feet of water. From the beginning of the Engineer surveys for the Illinois and Mississippi Canal, all reports and proposals had been predicated on the improvement of this other canal. In 1882, however, the Government refused an offer by the Illinois General Assembly to cede the rights to the Illinois and Michigan Canal to the United States (which was then supposed to improve it), and the canal had continued to deteriorate.

Except at high water seasons, the Upper Mississippi was not much better in 1908. For this brief period in its history, then, the Illinois and Mississippi Canal was too large for its connecting links.

It moved quickly from being too large to being too small. At the Mississippi end, Congress authorized a 6-foot channel from St. Louis to St. Paul on March 2, 1907, and work on that had already begun. The new Moline lock and a proposed lock and canal at LeClaire, Iowa, met the new 6-foot specifications with locks 350 by 80 feet. In 1912 a new water power dam at Keokuk drowned out the Des Moines Rapids and the small Government canal, replacing it with a new 400- by 90-foot lock.

The last chance for renovation of the Illinois and Michigan Canal ended in 1900 when the new Chicago Sanitary and Ship Canal, with a depth of 26 feet, opened to the Des Plaines River at Lockport, Illinois. In 1901 this spacious channel reached Joliet on the Illinois River. Plans for this channel had been drawn in 1892 by the Chicago Sanitary District to reverse the flow of the Chicago River which had been dumping raw sewage into Lake Michigan and contaminating the Chicago water supply. Its use by river traffic was an important extra, but the Illinois and Mississippi Canal now became the smaller canal of the system.

The Illinois and Mississippi Canal was further dwarfed during the 1930's by construction of the 9-foot channel between St. Louis and St. Paul, and by completion in 1933 of a similar project on the Illinois River. Locks on both rivers were now 600 feet long and 110 feet wide.

Size was not the only problem for the canal. Its opening in 1908 coincided with a steady decline of river traffic that continued for the next two decades. Use, then, of the canal was disappointing from the beginning. Its theoretical capacity, at extreme, was three boats per hour, each way, or 144 boats per day. At 640 tons each, and a navigation season of 200 days (the shortest possible), the canal was capable of handling 18,432,000 tons.[24] Even taking L.L. Wheeler's more realistic estimate of 90 boats per day, the canal could handle more than 10,000,000 tons per year, a figure the canal never came close to approaching.

As early as 1915, there was talk of abandoning the canal. Its peak use, reached in 1914, had only been 12,222 commercial tons. By 1915 the canal had not managed to attract a single private company to establish regular freight service—a necessity if the canal was to do well. Two grain elevators built along the feeder in 1910 by the Smith-Hippen Company shipped modest amounts of grain on the canal to distilleries in Peoria and Pekin, Illinois, but only a few other elevators were built along the canal. Even these modest grain shipments accounted for 55% of the canal's commercial cargo from 1909 to 1913.

In 1910 the Morton Salt Company shipped 1,200 tons of salt from Chicago to Davenport on the canal, but stopped after making another shipment of 2,000 tons in 1913 because of the deteriorating condition of the Illinois and Michigan Canal.[25]

Use of the Illinois and Mississippi Canal picked up briefly in the 1920's when the State of Illinois began improving the Illinois River. Several private firms began to offer services along the canal, and in 1929 the canal's use reached its all-time high: 30,161 tons, a bit over $\frac{1}{600}$ of its theoretical potential.

The Illinois and Mississippi Canal shortly after completion.

The River and Harbor Bill of July 3, 1930, provided a glimmer of hope for the canal by authorizing an examination of the canal to determine the feasibility of enlarging the channel to 9 feet and the locks to the size standard on the Mississippi's new 9-foot channel project. Part of this survey included a preliminary examination for a new 9-foot channel from Janesville, Wisconsin, to the head of the feeder at Sterling.

The report was not finished until 1937. In it, the Rock Island District noted that the existing limitations of the canal prevented its commercial success. The packetboat trade it had been designed for had been replaced by larger and more modern boats and barges. The report recommended improving the canal to the proportions consistent with the 9-foot channel.

A hearing was held in Washington, D.C., in 1939, at which a projected heavy use of an improved canal was argued. Proponents of improvement pointed out that construction would also provide many new jobs at a time of great unemployment. They also pointed out the irreversible nature of abandonment. The Chief of Engineers left the canal in limbo by refusing to recommend abandonment but also concluding that improvement was not economically feasible. Commercial traffic continued on the canal, but in gradually diminishing numbers.

Today, the canal is maintained by the State of Illinois as a recreation and wildlife area known as the Hennepin Canal State Parkway, with a visitor's center near Sheffield, Illinois.

In 1945 the Rock Island District Office issued another report favorable to improving the canal, but a review by the Board of Engineers for Rivers and Harbors concluded that the cost would be too great and the benefits doubtful.

Following this negative report, a last major decline in use of the canal began. Only 866 commercial tons moved on the canal in 1946, and 394 tons in 1947, all of it local traffic. On April 7, 1948, the Rock Island District issued a notice putting the canal service on a limited basis. With one day's notice, both commercial and recreational traffic could use the canal on Thursdays and Fridays. At

all other times, commercial traffic could use the canal provided they gave a week's notice.

No commercial tonnage was reported in 1948. The only supplies moved on the canal were for maintenance. The canal itself had deteriorated so much that less than four feet of water remained in the Rock River portion of the main line, with barely four feet remaining in the feeder.

In 1951 the Chief of Engineers suspended lock operations and everything but maintenance on seven canalized waterways that no longer served commercial traffic. Among these was the Illinois and Mississippi Canal. On June 21, 1951, Colonel B.C. Snow, Division Engineer of the Upper Mississippi Valley Division at St. Louis, issued a public notice for "Cessation of Operation for Navigation/Illinois and Mississippi (Hennepin) Canal." With this notice the canal ended its career as a navigable waterway.

The Hennepin Canal State Parkway. With the notice of closing, the Rock Island District Office began a detailed study of the difficult problem of what to do with the canal. The District considered several ways of disposing of the canal. They estimated that draining and abandoning the canal would cost $1,700,000, while putting the canal property back to its original pre-canal state would cost $10,000,000. Even minimal maintenance meanwhile would run more than $100,000 per year, a figure which a serious break or further deterioration would increase. Many of the highway bridges were in dangerous disrepair and needed replacing. The District Engineer recommended abandonment.

From the moment the canal closed, however, there was interest especially among area residents in turning the canal into a state or national park. These residents were supported by groups such as the Izaac Walton League and by prominent state figures such as Senator Everett Dirksen and Governor Adlai E. Stevenson. The canal was historically important as the last long stretch of canal left in the United States in reasonably complete shape, an im-

portance enhanced by its experimental use of concrete and other innovative construction methods.

Just as important to residents near the canal was its recreation potential. From its opening, it was as much used by excursion passengers—several thousand a year—as by commercial traffic. It had been used for fishing, swimming, and small boating. For example, the Rock Island YMCA in 1911 was given permission to hold swimming classes in the Milan section of the canal. The canal banks provided scenic areas for hiking and picnicking due to the Corps' planting of large areas of walnut, elm, and catalpa trees along the right-of-way for several years after the canal was opened. The trees came from experimental nurseries established by canal employees at nine places along the canal. The tree plantings helped stabilize and protect the banks from erosion. The tow path along this narrow forest was ideally suited to biking.

The idea of using the canal property as a state park grew more and more appealing to the state officials. With support from conservation groups and under the leadership of Governor Stevenson, the Illinois General Assembly petitioned the Federal government to keep the canal property for recreation and conservation use. As a result, the canal was placed on stand-by maintenance pending final disposal. From 1952 to 1955, the water level was reduced to five feet, and less than $100,000 per year was spent on maintenance. During this period the Illinois Department of Conservation and the National Park Service also recommended that the canal be modified for recreation.

In 1953 the Illinois House and Senate formed the Illinois-Mississippi Canal and Lake Sinnissippi Commission to look for ways of preserving the canal and the lake for recreation. Any such preservation would involve turning the property into a state or national park, but the Commission soon discovered that several difficulties lay in the way. First, the Federal government had obtained flowage easements to the land under Lake Sinnissippi rather than clear title. With the canal no longer a navigable waterway, the land may legally have reverted to the

original owners. Secondly, the Illinois Constitution prohibited the legislature from making any appropriations for railroads or canals, even, the Commission decided, for recreational use.

A third problem was funding. During the last years of the canal operation and into the fifties, little repair and only minimal maintenance was performed. Many canal structures, especially gates and bridges, were worn out. The Corps of Engineers had been reluctant to spend money unnecessarily while abandonment was a likelihood, and the State of Illinois could hardly afford to accept the canal in its existing condition and then restore it.

The legal hurdle regarding the use of state funds for canals was overcome by the Blue Ballot of 1954. This referendum removed the constitutional prohibition against the use of funds for canals.

After several unsuccessful attempts in the Illinois legislature to pass bills providing for rehabilitation of the canal and its transfer to state ownership in 1955-57, an Omnibus Bill was signed into law by President Dwight D. Eisenhower on July 3, 1958. The act authorized the Corps of Engineers to spend $2,000,000 to put the canal and lake into condition for recreation use and to work out a transfer agreement with the state. The bill also provided that the Corps would get fee and simple title to the land under Lake Sinnissippi and gave the State of Illinois permission to use the necessary water from the Rock River for canal recreation purposes.

In 1960 the Commission, the Corps of Engineers, and the State of Illinois worked out a renovation schedule using the $2,000,000 as far as it would go, with the work to be completed by 1964. All three groups knew that far more than $2,000,000 would be needed to meet the State's specifications. In 1962 Congress added another $800,000, still far from the estimate by the State and the Commission of $10,000,000.

During this period of transfer, two final attempts arose to renovate the canal for commercial use. In

1955 and again in 1965, local citizens campaigned actively to restore the canal and enlarge it to accommodate the growing river traffic on both the Illinois and Mississippi Rivers. By 1965, however, the estimated cost of such a project had risen to between $100,000,000 and $200,000,000, and the Corps of Engineers rejected another survey.

In 1965 Secretary of the Interior Stewart Udall toured the canal as a potential national park site, but he later rejected this option.

In 1969 representatives of Illinois and the Federal Government agreed on a final appropriation of $5,728,000 for rehabilitation of the canal. The work was to be done by the Corps of Engineers and the State was to accept title to the property before all the work had been completed. This paved the way for the acceptance by the State of Illinois on August 1, 1970, of full ownership and title to the Illinois and Mississippi Canal.

During the 1970's both the Corps of Engineers, using Federal funds, and the Illinois Department of Conservation, using state funds, continued restoration work.

All but four of the locks have had the upper gates replaced by concrete headwalls by the Corps to maintain a water level of five feet. Several of the bridges were removed and replaced by large culverts over which roadways were constructed. Some of this had been done by counties faced with unsafe bridges and strapped for money to replace them. Many of the wooden buildings—warehouses and shops—are gone, but others remain, including many of the houses constructed for overseers and lockmen. Most of the canal remains close enough to its original form to give a glimpse, at least, of what it once was.

Since 1970 the Department of Conservation has operated the canal as the Hennepin Canal Parkway State Park. Mile 13.8 through mile 17.9 has been designated as an interpretive area. This section includes all of the right-of-way, more than four miles

of prism and tow path, one aqueduct, and seven locks (15 to 21), including the working Marshall gate at Lock 16. The area also includes a railroad bridge, four highway bridges, including one of the original lift bridges, and eight overseers' and lockmen's houses.

Near mile 22 east of Sheffield, a Visitor's Center has been built on 400 acres of land that is being restored to prairie. In addition to information and exhibits, the Visitor's Center has day use facilities, a small boat harbor and launching area, from which a boater can travel all 40 miles of summit and feeder. The restored prairie at the Center contains a migratory waterfowl observation area and a natural plants demonstration area. A few miles east of the Center a portion of the north canal bank is maintained as original prairie.

Several places along the canal have been set up for picnicking and fishing. The towpath is kept mowed so that it can be used for biking and hiking. In winter all 104 miles of towpath are maintained as a snowmobile trail. Sections of the canal are kept stocked with game fish by the Department of Conservation. Near Wyanette is a canal campsite for tent camping.

The Hennepin Canal today has changed its name back from the title Congress gave it, and users are returning, not this time to haul coal or grain or gravel, but to enjoy what must be one of the most unusual state parks in the United States. More than 300,000 people each year now visit and use its facilities.

Notes

Chapter 5

Much of the detail of the planning and construction of the Illinois and Mississippi Canal is contained in the manuscript collections of the Chicago District and Rock Island District, Corps of Engineers. Nearly all of these manuscripts are located in two places: the Chicago Federal Records Center and in the historical files of the Rock Island District Office at Rock Island, Illinois. Here are the letterbooks of the officers in charge, reports of field operations by the engineers in charge of each section, surveys, bills of goods, etc. The Chicago Federal Records Center has most of the reports by the District Engineers in charge of the project, while the Rock Island District files have most of the reports of field operations submitted by L.L. Wheeler and James C. Long. Both manuscript collections are extensive. In addition, the Rock Island District Office has a large collection of construction photographs, as well as maps, charts, and drawings of the canal and its structures.

The details of the planning and construction of the canal assembled by Mary Yeater for the National Register of Historic Places Inventory have also been most helpful, particularly in the details of construction. The description of the canal that Ms. Yeater assembled for the National Register is the single most complete source of information on the Illinois and Mississippi Canal.

1. Madeline Waggoner, *The Long Haul West*, (New York: Putnam, 1958), p. 15.

2. *Ibid.*

3. John Joseph Steinbach, "History of the Illinois and Mississippi Canal," Unpublished M.A. thesis, Illinois State University, 1964, p. 4.

4. The Geneseo *Republic*, March 6, 1834, p. 1.

5. *Ibid.*

6. U.S. Congress, House, *Report of Brevet Maj. Gen. James H. Wilson, Lieutenant Colonel Thirty-fifth Infantry, on the Survey of the Rock River in the States of Illinois and Wisconsin*, Executive Doc. 15, 40th Congress, 1st Session, p. 1.

7. *Ibid.*, p. 10.

8. *Annual Report*, 1891, p. 2634.

9. *Annual Report*, 1883, p. 1709ff.

10. Steinbach, p. 19.

11. *Annual Report*, 1887, p. 2145.

12. Wilbert L. Bonney, "Descriptive and Historical Sketch of the Illinois and Mississippi Canal," reprinted from the *Annual Report*, 1908, p. 7.

13. O.H. Ernst, Letterbook No. 1, Northwest Division, Rock Island District, 1901—, RG77, Chicago Federal Records Center.

14. *Annual Report*, 1891, p. 2650.

15. *Ibid.*, p. 2651.

16. William A. Davis, *History of Whiteside County, Illinois* (Chicago: The Pioneer Publishing Company, 1908), p. 283.

17. The Rock Island *Argus*, October 22, 1907, p. 5.

18. Major W.L. Marshall, "Illinois River," Record Book No. 10, Chicago District, RG77, Chicago Federal Records Center.

19. Colonel O.H. Ernst.

20. Bonney, p. 12.

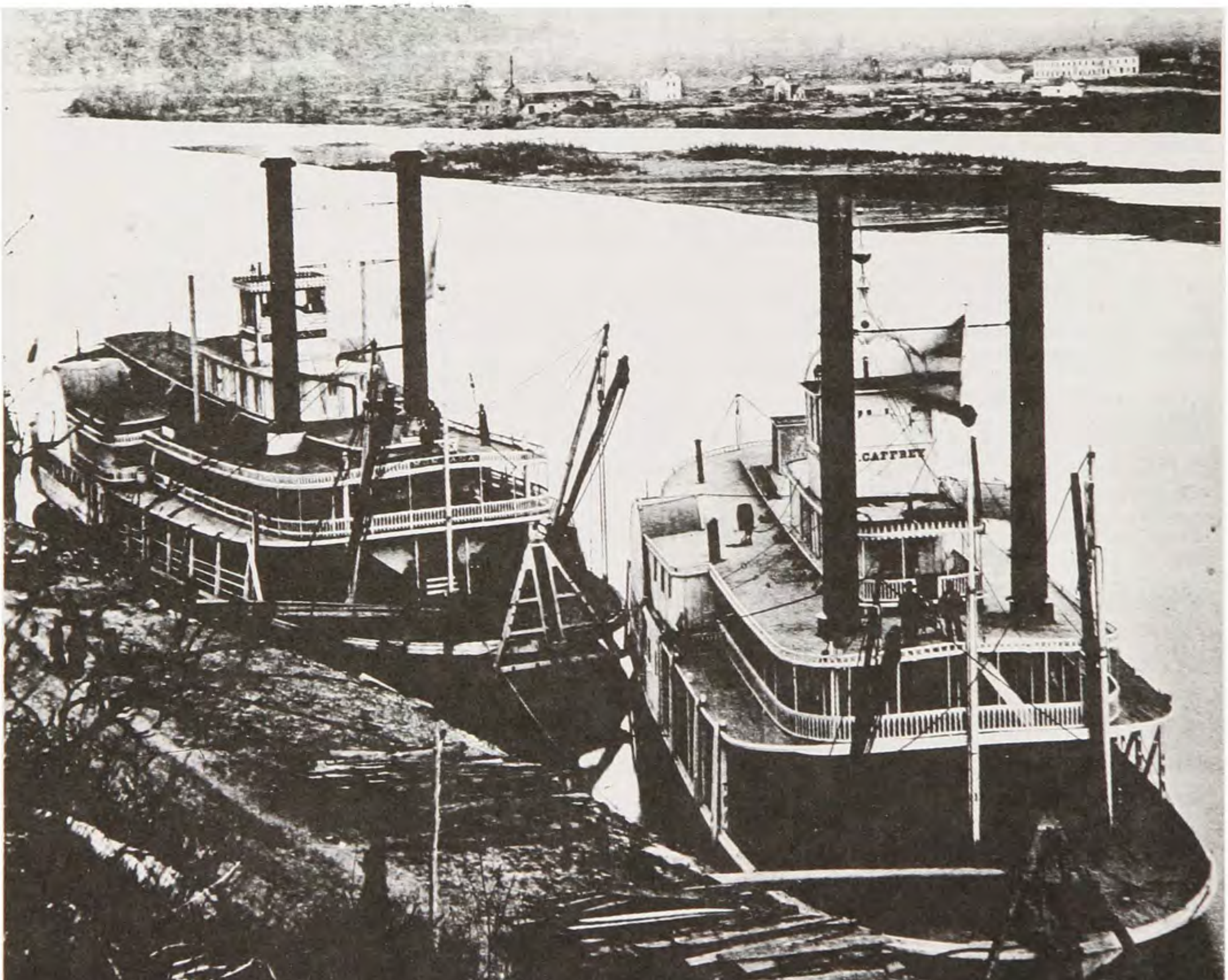
21. Major Charles Riche, Letter to the Chief of Engineers, August 13, 1907, Letters Sent, Rock Island District, Rock Island District Historical Files.

22. Mary Yeater, "Hennepin Canal Historic District," National Register of Historic Places Inventory—Nomination Form, Section 8, p. 18.

23. *Ibid.*

24. *Ibid.*, p. 19.

25. *Ibid.*, p. 21.


CAFFREY

Chapter 6

The Rock Island District Fleet

The *Montana* and *Caffrey*, purchased by Major G. K. Warren in 1867, became the first boats of the Rock Island District. Here they are shown at the St. Paul waterfront, outfitted as dredge and snagboats. The wooden triangles at the bow are Long's scrapers.

Although much of the improvement work done by the Corps of Engineers on the Upper Mississippi since 1866 was done by contract, as Congress wished, the experimental nature of the early work demanded close supervision by the Corps, and frequently, construction by the use of hired labor as well. Then, too, until the work of improvement was well under way, contractors lacked the equipment required by the many different kinds of improvement. In 1879, for example, when the 4½-foot channel project began, there were only four privately-owned dredges on the Upper Mississippi. Contractors were not about to invest in specialized and expensive—and often experimental—equipment until more regular appropriations made it clear that Congress was serious about navigation improvement. Because of irregular funding, few improvement projects before 1866 were ever carried through and completed. Finally, most of the early contractors with enough experience to bid on river navigation projects were Eastern firms who had difficulty moving equipment so far.

THE ROCK ISLAND DISTRICT FLEET

The result was a Rock Island District boat fleet. As the number and complexity of projects on the Upper Mississippi expanded, the Rock Island District gradually developed an impressive fleet of boats of all shapes and sizes: towboats, tenders, snagboats, canal boats, dipper and hydraulic dredges, quarterboats, buildingboats, barges, launches, and skiffs.

It was for the beginnings of this fleet that the District, under prodding by Montgomery Meigs, established a dry dock and machine shop alongside the Des Moines Rapids Canal in 1883. Between 1895 and 1908 this was followed by three more boatyards: one at Fountain City, Wisconsin; one at South Stillwater, Minnesota; and the Silver Lake Boatyard operated in conjunction with the Milan section of the Illinois and Mississippi Canal. Here the Government plant was kept in repair; the yards at Stillwater and Silver Lake also provided winter quarters for the fleet.

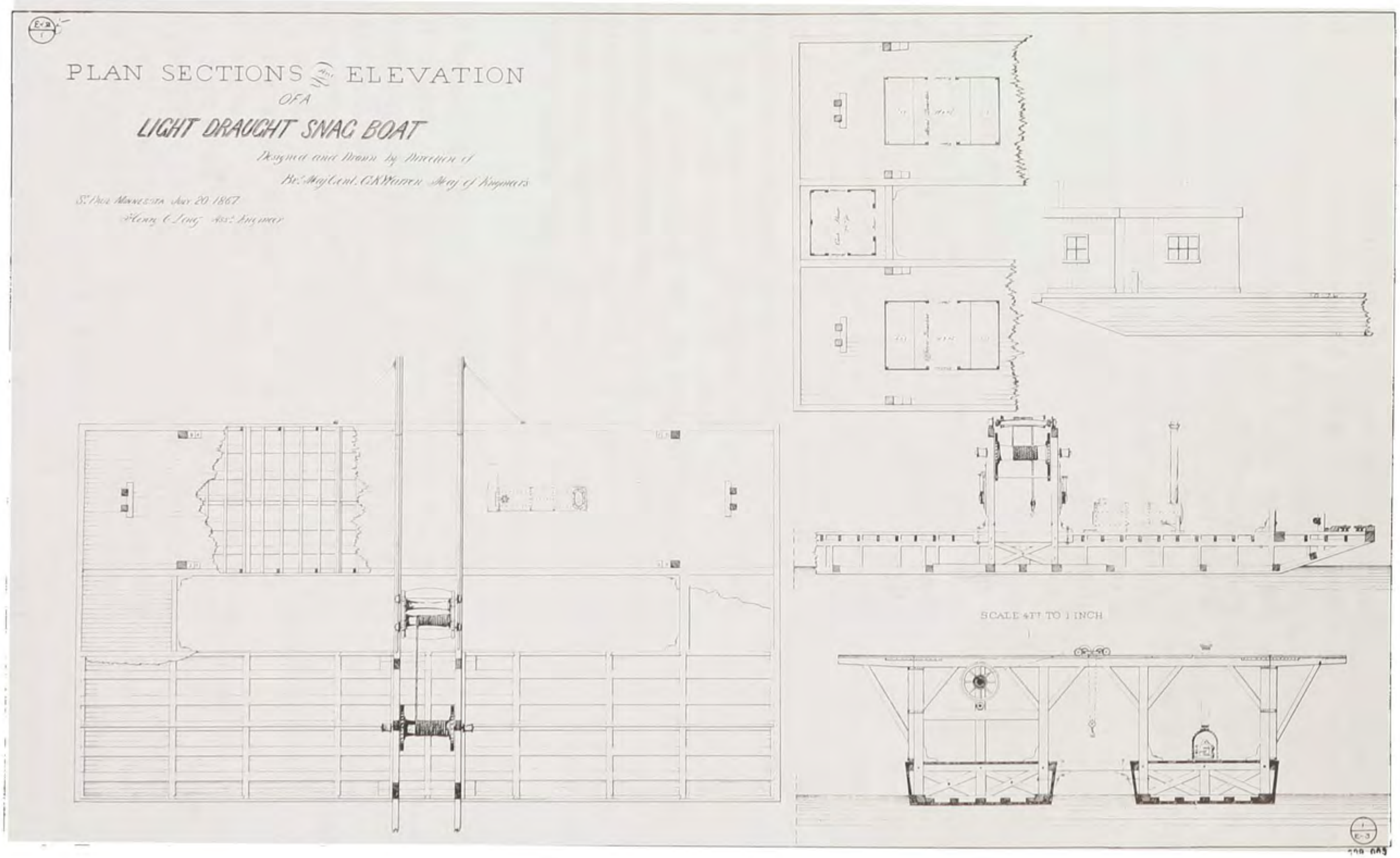
Rock Island District boats were not only repaired and wintered at these yards; many boats designed by Meigs and other engineers were built here. The Des Moines Rapids Canal Dry Dock remained the major installation, and the large steamboats were built there. The Fountain City and Stillwater boatyards were used to construct barges and quarterboats, and an occasional dredge. At the peak of their activity from 1890 to 1910, work at these boatyards far outstripped the output of any other Engineer district in the United States, building, rebuilding, and servicing a Rock Island District fleet of more than 200 named boats.[1]

Montgomery Meigs remained in charge of the boatyard he had built at Keokuk, while the other three boatyards were in local charge of the assistant engineers responsible for the sub-sections of the District (which had been established by Colonel Mackenzie). J.D. DuShane was in charge of the Stillwater yard, William Thompson of the Fountain City yard, and L.L. Wheeler operated the Silver Lake yard as part of his canal responsibilities. The yards serviced boats and barges operating in their

own section, but they did other work as needed as well. In fact, when Major Riche expanded the Fountain City boatyard and added the Stillwater yard, he had in mind building barges and other floating plant for other districts on the entire Mississippi River, but, as C.W. Durham, chief of the engineering section at Rock Island noted, "steel and southern pine knocked that out."[2] Nevertheless, for a year or two, as the District prepared for the 6-foot channel project, there was plenty for the boatyards to do.

With the coming of the 9-foot channel, done mostly by contract work, the need for such an extensive fleet disappeared. As the limits of the Rock Island District contracted, boats were transferred to the St. Louis and St. Paul Districts. The Stillwater Boatyard lasted only several years and the Fountain City yard went with that section of the river to St. Paul. The Des Moines Rapids Canal shops disappeared with the canal in 1912 and were replaced with a dry dock, but minus the boat building facilities. The last of the large boats, the "million dollar dredge" *Rock Island*, was transferred out of the District in 1958. Today the District maintains a modest fleet of towboats, tenders, and workboats, but the hiss of the steam engine and the slap-slap of the paddles are long gone.

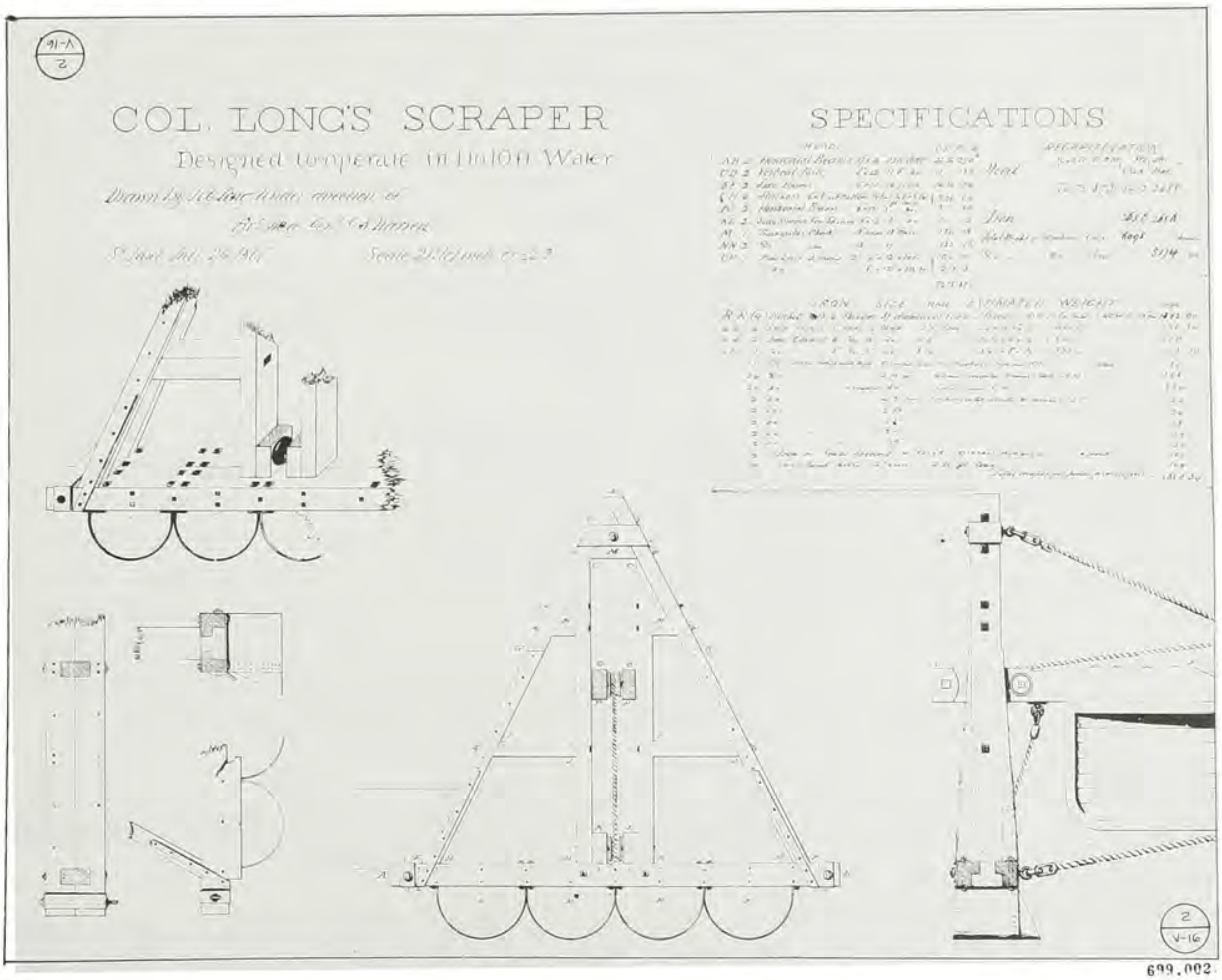
The first steamboats in the Rock Island District were the *Montana* and the *Caffrey* bought by Warren in St. Louis in 1867. Warren had previously purchased a quarterboat and several small skiffs for his survey crews in the fall of 1866, but these were moved from place to place by rented boats or commercial packets. Wilson at Keokuk had been given no appropriations for boats at all. Warren had requested an appropriation for Wilson to buy boats, claiming that the rapids work was suffering for lack of transportation,[3] but finally Warren lent his own boats to the Rock Island Rapids project. The Des Moines Rapids work had one small canal boat drawn by horses. Meanwhile, Wilson's assistants Lieutenant Charles Allen and E.F. Hoffmann moved from place to place by obtaining free passes on commercial packets.[4]


PLAN SECTIONS and ELEVATION
OF A
LIGHT DRAUGHT SNAG BOAT
Designed and Drawn by Direction of
Bvt. Maj. Genl. G.K. Warren Maj. of Engineers
St. Paul Minnesota July 20 1867
Henry C. Long Asst. Engineer
SCALE 4 FT TO 1 INCH

Plans for a light draft snagboat for work in the shallower waters of the Upper Mississippi, designed by Major G. K. Warren in 1867. More like a barge, this boat had no power to work on its own.

The *Montana* had been built for the Missouri River trade and the *Caffrey* for the Tennessee River. Both boats required extensive modification to suit them for their Upper Mississippi snagging and dredging operations. The work was performed at the dock yards of the N.W.U. Packet Company at LaCrosse, Wisconsin, and at St. Paul. The boats had their forward guards removed, and the boiler and hurricane decks reduced. In addition, the *Caffrey* had its Texas deck and the superfluous parts of the cabin removed. Both boats were fitted with Long's Scraper for dredging (though Warren placed these in the bow rather than in the stern where Long had placed them). The *Montana* was also fitted with swinging cranes of 15 tons lifting power each for snag removal. As a pilot for the *Montana*, Warren hired David Tipton, one of the most respected men

Major Warren adapted Long's Scraper for Upper Mississippi use in 1867, and installed them on both the *Montana* and *Caffrey*. The scrapers dredged sandbars by stirring up the mud or sand so that the current could carry it away.



699.002

on the river. David Tipton had begun as a keelboatman; he continued in the service of the Rock Island District until he dropped dead at the wheel of his boat in 1904 at the age of 84.[5] The last of the District snagboats was named the *Tipton* in his honor after he died.

Warren was able to operate the *Montana* and *Caffrey* very economically. The total cost of wages, fuel, and food came to about $100 per day per boat. The cost of operating commercial packets on the Upper Mississippi during this same period ran between $350 and $650 per day.

In 1868 Warren bought a small raftboat, the *Winneconne,* for the Wisconsin River improvement. The boat cost $8,500 and was well built for snag operations because of her rafting equipment. Low water in 1868 prevented her from working on the Wisconsin that season. During the 1869 season she was employed cleaning out snags between Portage and Sauk City, but her draft was troublesome on the shallow river. Warren recommended cutting the boat in two and lengthening the hull to decrease the draft, but this was not done.

When Warren left his duties on the Upper Mississippi, the boats he had assembled were transferred to Macomb.

In 1877 Macomb received authority to buy a dredge for the Des Moines Rapids Canal work. This boat was the dipper dredge *Ajax,* built at Quincy, Illinois, in 1876 by H.S. Brown, for which Macomb paid $11,500. The *Ajax* was a medium boat 73 feet long with a 26-foot beam and a 3-foot, 5-inch draft. The steam hoisting engine operated a 1½-cubic yard dipper at the end of a 30-foot boom. The *Ajax* served as the canal dredge until after World War I.

Also in 1877 Macomb bought a small steam launch, the *Iris,* for $350 to use in the improvement of the Burlington, Iowa, harbor.[6]

The first boats designed by District personnel specifically for District projects were built the

following year, in 1878, when Major Farquhar improvised two steam drill scows in an attempt to improve rock excavation at the Rock Island Rapids. These have been described in Chapter 3. The drilling scows were used at the Des Moines Rapids in the channel between Nashville and Montrose. (See illustration on page 94).

During the fall and winter of 1878-79 the machinery and deck of the worn-out *Montana* were put in a new hull by D.S. Barmore at Jeffersonville, Indiana, home of several early ship-building firms. The new boat was named the *General Barnard* in honor of the man who had been Chief Engineer of defenses of Washington and Chief Engineer of the Armies in the Field under Grant during the Civil War. General Barnard had refused a nomination from President Lincoln to become Chief of Engineers following Totten's death. In 1878 General Barnard had been appointed to the Board on Improvement of the Low-water Navigation of the Mississippi and Missouri Rivers.[7] The *Barnard* arrived in Rock Island on April 24, 1879.

The practice of rebuilding worn-out boats into new ones with new names was a common practice on the Mississippi where machinery was expensive and the hulls subject to frequent wrecks and the natural effects of being in water and ice. When the *General Barnard* was condemned in 1900, however, it was replaced by an entirely new boat, the *Colonel A. Mackenzie.* Only the dishes and a few items of furniture from the *Barnard* went with the new boat. The *Mackenzie* was renamed the *David Tipton* in 1907 (after only slight modification), and served as the District snagboat until 1921.

The *General Barnard* was the grandest boat ever built for the Rock Island District. Because the machinery of the *Montana* was used in her construction, her total cost was only $21,000. For this, the District got a sidewheel steamboat whose overall dimensions were 220 feet long with a 64-foot, 3-inch beam (extending out over a 37-foot-wide hull), and a 5-foot hold. Her wheels were 25 feet in diameter with 12 buckets on each wheel. She contained a total of 17 staterooms, of which the six aft

The Rock Island District snagboat *General Barnard*, built in 1879 using machinery and parts from the *Montana*. At 220 feet, displacing 500 tons, with 25-foot sidewheels, the *Barnard* was an imposing leader of the District fleet.

rooms were 9 by 12 feet. On her decks a crew of 15 to 38 lived and worked. From the waterline to the top of the pilot house she stood 44 feet, 6 inches. She was 55 feet, 5 inches to the top of her stacks. Yet in the best Mississippi River tradition, she carried her 500 tons on a draft of only 39 inches.

In her 22 years, the *General Barnard* removed 38 wrecks, 6,584 snags, cut and removed 73,935 leaning trees, pulled back 1,621 trees, assisted 82 steamboats off bars, and traveled 130,732 miles in service of the Rock Island District. Following her initial cruise in 1879, C.W. Durham, who became Master of the boat for several seasons, wrote to Mackenzie: "I have the honor to state that the *General Barnard*... has fulfilled my most sanguine expecta-

tions, and is admirably fitted for her work."[8] The *Barnard* was condemned on August 22, 1900, and sent to Jeffersonville, Indiana, where she was sold at auction for $1,000.

In addition to the *Barnard*, Mackenzie added four small steam launches to the fleet in 1879: the *Mary*, *Bessie*, *Irene*, and *Wasp*. These were used as dredge tenders, towboats, inspection boats, and for general purpose work on the Des Moines Rapids-to-St. Paul section of the 4½-foot channel project. The boats were built at Rock Island with engines constructed at the Rock Island Arsenal. At least one, the *Irene*, was designed by Montgomery Meigs, the first of a long series of Meigs' designs.

The River and Harbor Bill of March 3, 1881, provided for construction of a light-draft snagboat to be used to assist the *General Barnard*. Then on April 4, the Chief of Engineers authorized Mackenzie to build two medium towboats. All three of these boats were designed by Montgomery Meigs.

The two towboats, the *Fury* and *Vixen*, were built during the spring and summer of 1881 by Joseph Reynolds of Dubuque. They were identical sternwheel boats, 100 feet long with a 20-foot beam and a 26-inch draft. Their wheels were 13 feet in diameter. The *Fury* (U.S. Towboat No. 2) came off the ways on October 3, 1881, and the *Vixen* (U.S. Towboat No. 3) on November 10. Each boat cost $12,000.

The snagboat was designed and drawn during the fall of 1881 and built in the winter and spring of 1882 by Howard and Company of Jeffersonville. This boat, the *J.G. Parke*, was 140 feet long with a 28-foot beam and a 4-foot draft. Most of the Government boats built for improvement work were plain and functional, but the sternwheel *Parke* was a beautiful boat with an ornate pilot house and gingerbread trim in the best riverboat tradition. The *Parke* was named after the Engineer officer who was a member of the party that in 1849-50 had determined the Iowa-Minnesota Territory line, and who served as chief astronomer and surveyor of the party marking the Northwest Boundary in 1857-61.

The *Barnard* was replaced as the District snagboat in 1900 by an entirely new boat, the *Colonel Alexander Mackenzie.*

The boat cost $18,750, and performed snagging and other operations in the District until 1904, when she was condemned and broken up.

Two other steamboats were purchased in 1881, the *Alert* (U.S. Towboat No. 1) and the *Coal Bluff,* a large boat 148 feet, 7 inches by 28 feet, 4 inches, weighing 175 tons. These boats went to work on the section of river from the Des Moines Rapids to the mouth of the Illinois River. During the disastrous floods in the spring of 1882, the *Coal Bluff* and the *Barnard* were sent to the relief of flood victims below St. Louis. The *Coal Bluff* carried 1,689 barrels of meal, 383 boxes of bacon, 17 bales of tenting, and other freight on this trip to Vicksburg.

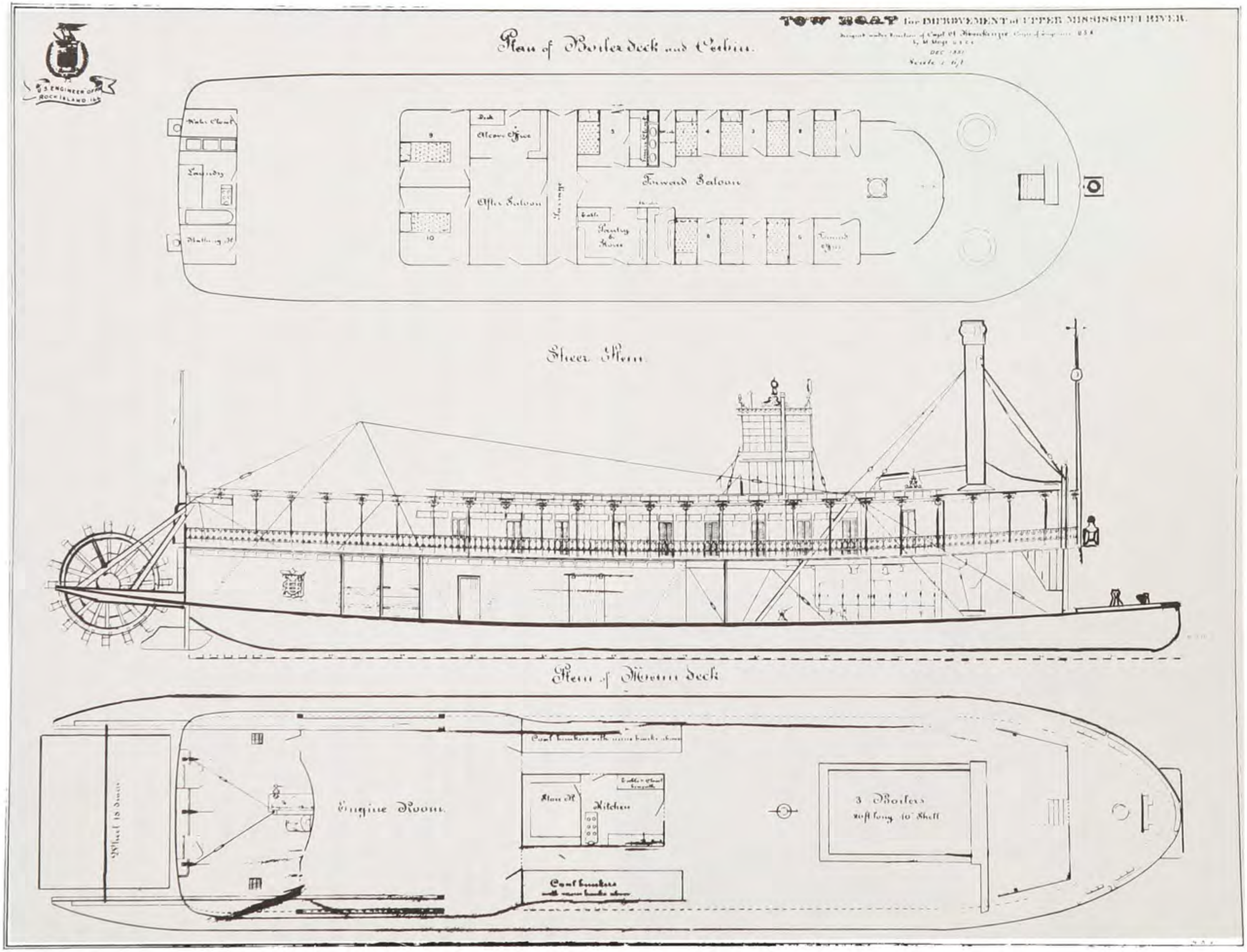
The *Coal Bluff* was another of the District boats with miraculously long life, still going strong in 1922. The District fleet received good care, undergoing frequent repair and rebuilding, with the result that it was not unusual for these wooden boats to last 30 or more years, in contrast to the fleeting life of the average commercial packet. The *Geyser* may

The practice of modifying older boats into new ones can be seen by comparing this photo of the *David Tipton* with that of the *Mackenzie*. The *Mackenzie*, with minor modifications (including a Texas deck), became the *Tipton*.

hold the record. This small dredge was built by Meigs at Keokuk in 1893 and worked until it sank next to the dry dock at Keokuk in the late 1940's.

The careful repair in which the District boats were kept was expensive, and maintenance costs of nearly all of the boats far exceeded their original cost. The *Coal Bluff*, for instance, which had been purchased for $8,000 in 1881 when it was three years old, cost $76,220 to maintain through 1917. The *Alert* was bought by the Government for $6,000 and ran up a repair bill of $38,822 by 1917.[9]

By 1882, in addition to the above steamboats, the Rock Island District fleet consisted of 55 stone barges and the necessary complement of quarterboats, pile drivers, and fuel flats. However, there were still not enough boats and machinery on the Upper Mississippi either in Government or private hands, to carry out the 4½-foot channel project at the rate it was being funded by Congress. In 1882 Assistant Engineer E.F. Hoffmann investigated

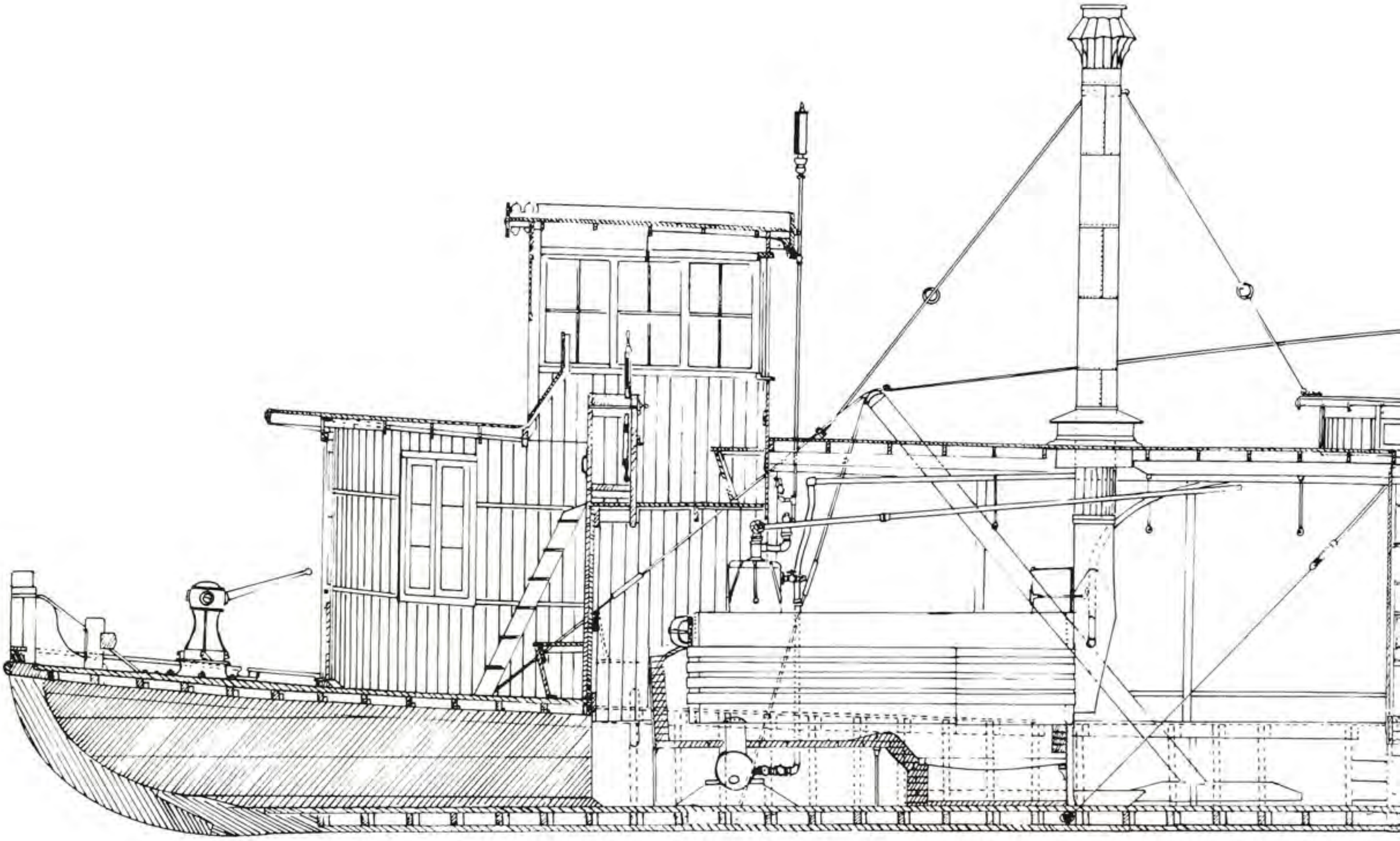

TOW BOAT for IMPROVEMENT of UPPER MISSISSIPPI RIVER.
U.S. ENGINEER OFFICE ROCK ISLAND, ILL.
Plan of Boiler deck and Cabin.
Water Closet
Laundry
Alcove Office
After Saloon
Forward Saloon
Pantry & Stores
Sheer Plan
Plan of Main deck
Wheel 18 diam
Engine Room
Kitchen
Coal bunkers
with crew bunks above
3 Boilers

Plans of the Rock Island District steamboat *J. B. Parke,* the grandest of all the boats designed at Keokuk by Montgomery Meigs.
—National Archives

different types of dredges at Keokuk, Chicago, and Beardstown, Kentucky, and decided that a boom dredge was best suited to work on the river. Such a dredge, the *Vulcan,* was added to the fleet in 1883. An 80- by 30-foot hull was built by Jacob Eckhart at Davenport, with plans furnished by the Osgood Dredge Company (who furnished the machinery for this and many other private and Government dredges). The hull was taken to the canal shops at Keokuk where an expert from the Osgood Company installed the machinery. The 1¾-cubic yard capacity of the dipper made the *Vulcan* slightly larger than the *Ajax.* The boat displaced 210 tons, drew 3 feet of water, and carried a 5 days' supply of coal. The total cost of the *Vulcan* was $29,348.11. It was placed in operation on August 8, 1883.

Two small steam launches, the *Stella* and *Louise,* were designed and built for towing purposes at the canal shops in 1884. In 1885 a third dipper dredge similar to the *Vulcan* was built for the Rock Island District at Metropolis, Illinois. This was the *Phoenix,* which worked in the District until 1916 when she was sold to the St. Louis District.

The U.S. Steam Launch *Lucia,* named after one of General Alexander Mackenzie's daughters. The *Lucia* was designed and built by Montgomery Meigs at the Government boatyard in Keokuk.

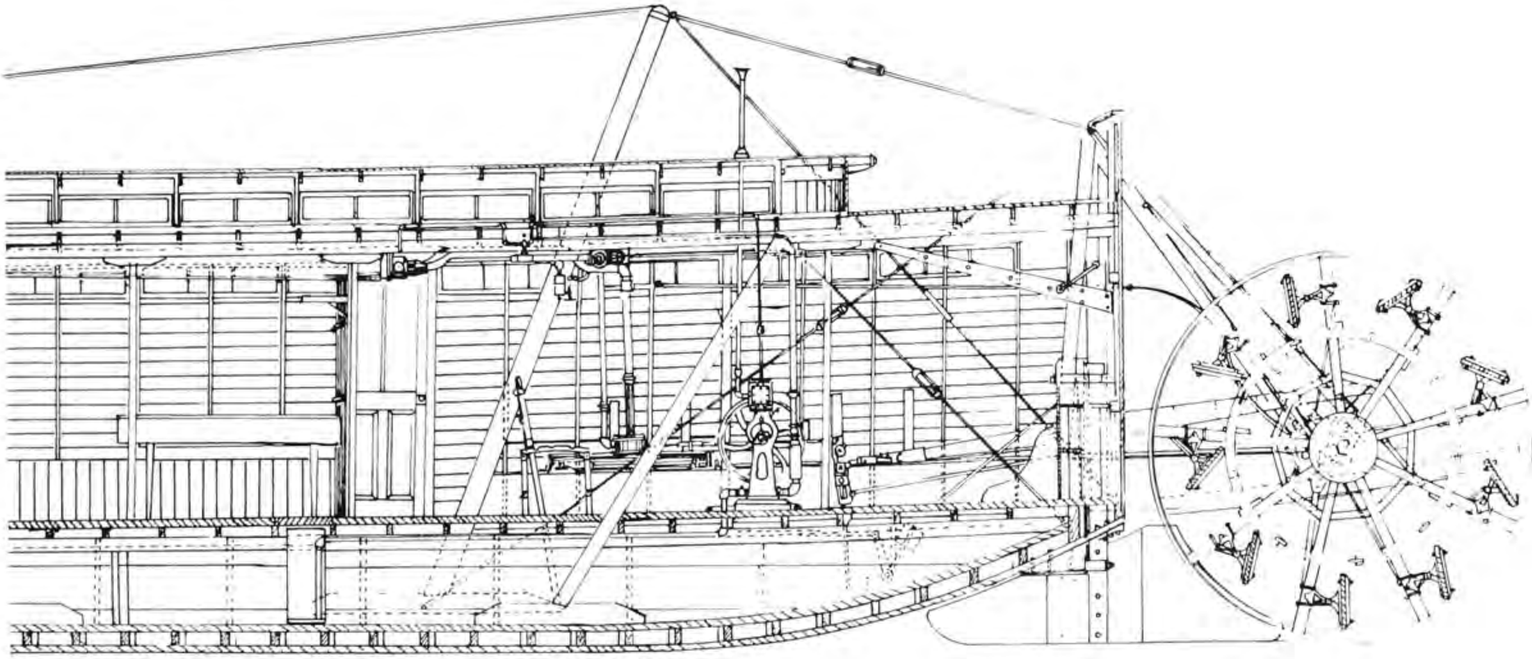


Side view of the steam launch *Lucia*.
—Redrawn by Randall Tweet, from original plans in the National Archives.

Montgomery Meigs designed and built another small steam launch at the canal shops in 1885. Named the *Lucia* after one of Mackenzie's daughters, she soon became the sweetheart of the Rock Island fleet. She was a plain-looking boat, but of all the boats Meigs designed, she remained his favorite.

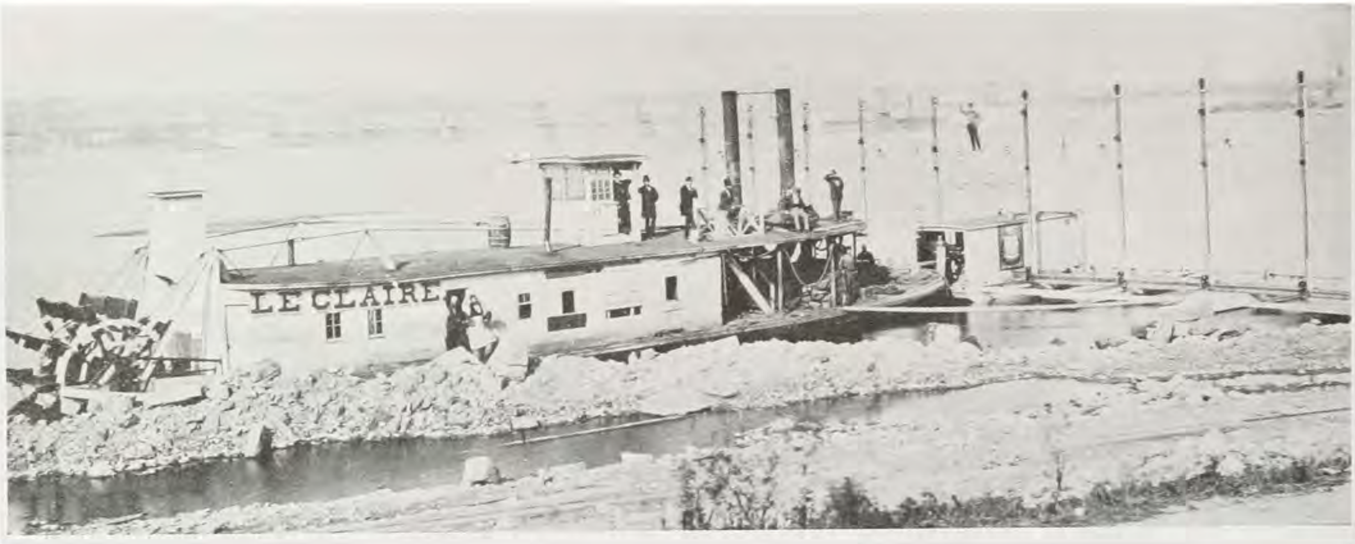
The *Lucia* was the Upper Mississippi's equivalent of "the little engine that could." Smaller than most of the District boats, with a 78-foot length, a 16-foot beam, and a 24-inch draft, her 9-foot sternwheel turning 25 revolutions per minute, the *Lucia* performed a wide variety of tasks on the Mississippi. She acted as a dredge tender, she towed barges, placed buoys on the rapids, got booms in for the winter, worked on levees during floods, and carried distinguished visitors up and down river.

During periods of flood (which were frequent through the 1880's), she worked the bottom lands



where the Des Moines River meets the Mississippi. When this area flooded, the *Lucia*, rowboats in tow, would paddle around the flood plain rescuing people from roofs and upper windows. The rowboats would bring them to her crowded decks. At night during the floods, the *Lucia* would turn her searchlight straight up to act as a beacon for boats engaged in rescue work.

Corneila Meigs, the daughter of Montgomery Meigs and a well-known author, remembered the *Lucia* well. In a letter to the Rock Island District, she recounted how the *Lucia's* pilot-captain, Billy Adams, and her engineer, Tom Noonan, had worked faithfully on the boat for 20 years without speaking to each other, for they were sworn enemies. When the *Lucia* capsized in a tornado just above the Keokuk bridge, Adams was not on board, but Noonan died at his engines trying to keep up power, one of the very few fatalities in the history of the District fleet.



The automatic sounding machine designed by Colonel J. N. Macomb, and later named after him, attached to the steamer *Le Claire.*

The *Lucia* had her hull rebuilt in 1895, and kept at her work until well after World War I.

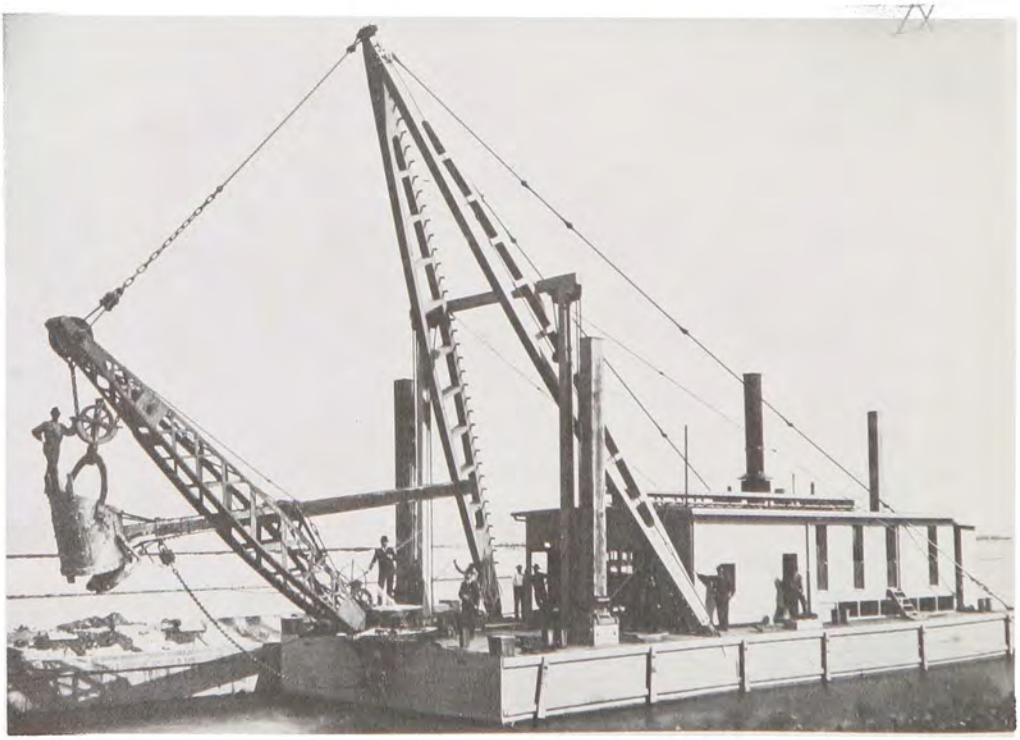
By 1887 the Rock Island District had 11 steamboats and some 100 barges, dredges, dump boats, and quarterboats. A portion of these were transferred to Captain Ernest H. Ruffner when he became engineer in charge of the section of the Mississippi from Keokuk to the mouth of the Illinois River under the Mississipi River Commission in 1884. Among these were the *Coal Bluff,* the *Iris,* and the *Irene.* In addition, Ruffner bought a new small steamer, the *Success,* from H.M. Horton of Pomeroy, Ohio, for $6,500 in March of 1887. Originally the *Success* was to have acted as a dredge tender for a new hydraulic dredge that Ruffner intended to experiment with. Previous hydraulic dredges on other river systems had been used with mud and silt, but the sand of the Upper Mississippi presented new problems. However, all bids for the dredge were too high. Ruffner solved the problem by determining to make the *Success* herself into a hydraulic dredge. New dredge machinery was ordered and the *Success* was altered to fit this equipment.

Some sort of hydraulic dredge was badly needed on the improvement projects. Dipper dredges worked well on rock, but in sand the bars reformed as quickly as the dippers were able to take sand away.

During the fall and winter of 1887 the *Success* was outfitted with the machinery. Three boilers furnished steam for a 12-inch centrifugal pump, the force pump, a steam hoister, and the *Success's* own engine. Attending her was a fleet of flats bearing 500 linear feet of discharge pipe.

Due to reduced appropriations the *Success* was not put into commission until August of 1888. Her first job was to aid the St. Louis and St. Paul Packet Company, whose famous boat *War Eagle* had been aground for a long time. After pumping for 36 hours, the *Success* freed the large packet. Appropriations became available on August 11, and the dredge moved to Whitney's Bar Crossing for her first experience in pumping river sand. This first use of a hydraulic dredge on the Upper Mississippi was a good one and led the way for the much larger hydraulic equipment which was to come.[10]

The Rock Island District Boatyard at Fountain City, Wisconsin, with the hydraulic dredge *Vesuvius* nearing completion on the ways.



Apparently the hard work demanded of such a small boat was too much, for the *Success* lasted only until 1893, the year the section of the river in Captain Ruffner's charge was transferred back to Mackenzie.

A steam drill boat at work preparing holes for underwater blasting.

As the work on the 4½-foot channel expanded from 1890 to 1900, the Rock Island District fleet gradually increased. By 1903 the Corps owned 20 steamboats, 4 dipper dredges, two new hydraulic dredges (the *Geyser*, built in 1893, and the *Hecla*, built in 1901 by William Thompson at the new Fountain City Boatyard), 22 quarterboats, 18 office boats, 3 steam drill boats, more than 100 barges, store boats, dump boats, derrick boats, and a large number of small powder boats, grasshoppers, skiffs, and loading boats.

The coming of the 6-foot channel project increased the need for larger towboats and more powerful dredges. In 1907 the District boatyard at Fountain City was expanded, a new boatyard begun at Stillwater, Minnesota. Stillwater was not really central to the St. Paul-to-Winona District which the boatyard was to serve; it was 23 miles up the St. Croix River and inaccessible at low water. But it was an inexpensive site. The land for the new yard cost $1,500, and had already been the site of a previous boatyard, the Stillwater Marine Ways Company, whose buildings were still standing and usable. Further, the boatyard connected to Stillwater by electric car, was on the line of two railroads, and had an excellent bay for harboring the District fleet in the winter. And unlike St. Paul, which might have been a more logical location, Stillwater was a small town where, as DuShane noted, "labor troubles will be at a minimum."[11]

A typical dipper dredge added to the Rock Island District fleet for the 6-foot channel project.

Not everyone in the District Office agreed with Riche's expansion of building and repair facilities. C.W. Durham, chief engineer under Riche, complained about the expansion from the beginning. Finally, after the yards had been built and had proved themselves to be expensive, with a workload under what Riche had hoped, Durham ended his series of memos with an I-told-you-so note signed "The Juggler." The facts, wrote Durham, "ought to be plain

The hydraulic cutter dredge *Rock Island,* added to the fleet in 1937. At 230 feet, displacing 1,500 tons, this "million dollar dredge," as she was known, was the largest boat ever to be a part of the Rock Island District.

A District quarterboat, typical of those used to house hired labor in the field.

enough even to a man from Missouri. . . The mistake made and one which I have fought against from the beginning is in imagining that you were going to start *4 big factories* where all the work you have in sight for 20 years will not keep *one* busy!!!"[12] Instead, Durham suggested, all of the new work required could have been handled by "a few pneumatic tools and a steam saw."[13]

The Stillwater Boatyard was phased out after completing construction from the last of the 1911 appropriations. The Fountain City Boatyard continued to serve the Rock Island District until it was transferred to the St. Paul District. It now serves as a service base where the St. Paul District dredge

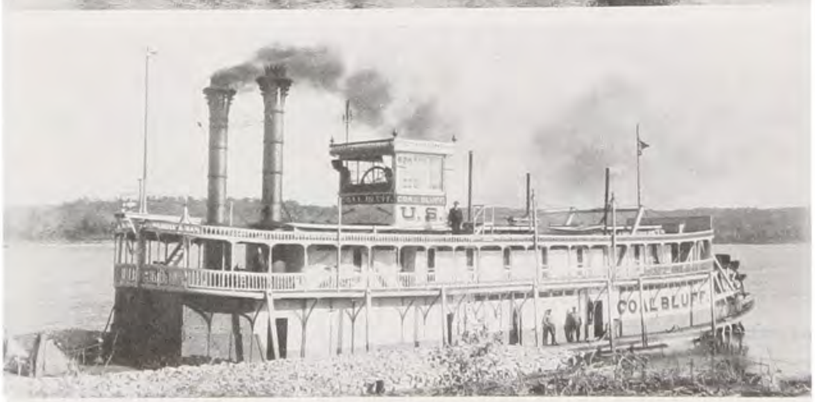
William Thompson and several other boats are stationed. The Des Moines Rapids dry dock, which replaced the old canal dry dock in 1912, still exists, but a permanent coffer dam has replaced the gates to safeguard its deteriorating condition.

In June 1907 when the first of the appropriations for the 6-foot channel was authorized, Riche received permission to build two 15-inch and one 18-inch hydraulic dredges at the Government boatyards. One dredge was built at each of the yards. The *Vesuvius*, built by William Thompson at Fountain City, was 115 feet long with a 30-foot beam and a 31-inch draft. It displaced 218 tons and used 17-inch discharge pipes. A sister ship to the *Vesuvius*, the *Pelee*, was built at South Stillwater Boatyard by DuShane, while the third dredge, the *Etna*, with 18-inch discharge pipes, was built by Meigs at Keokuk.

These three dredges were capable of far more work than the earlier dredges. The *Etna*, for example, pumped an average of 287.7 cubic yards an hour, 3,230.7 yards a day. She made a cut 5 to 7 feet deep moving ahead at 14.7 feet per hour. In 1917 the *Etna* dredged 252,694 cubic yards — about as much as was removed during the whole Rock Island Rapids improvement.

An appropriation of $1,000,000 in 1910 provided for three additional 18-inch hydraulic dredges. Design and construction of these dredges was assigned to Meigs at Keokuk. They were completed in 1912.

Naming of these three dredges proved to be as difficult as building them. DuShane at South Stillwater in 1908 had suggested "Popocatopetl" as the name for what became the *Pelee*. The naming of boats apparently got further out of hand when District Engineer Major Charles Keller asked Meigs to pick names for the new dredges. On September 10, 1910, Keller notified Meigs that his names (what these were is not known) were not satisfactory and to try again,[14] but a week later Keller wrote to Meigs informing him that he was "respectfully requested to name the new dredges Warren, Macomb, and Farquhar."[15]



The *Ellen,* flagship of the District fleet during much of the 9-foot channel project. The *Ellen* was known as the "District Engineer's royal barge."

Several workhorses of the District fleet. Right, top to bottom: the small hydraulic dredge *Geyser,* which worked from 1893 until she sank near Keokuk in the late 1940's; the towboat *Muscatine,* one of the "silo boats" (so-called because of its height and the forward placement of its pilot house); the steamer *Coal Bluff;* the 65-foot steam launch *Ruth,* companion to the *Lucia.*

The Corps of Engineers, however, had begun a policy which discouraged naming boats after Engineer officers because of the difficulties this had caused. (The Rock Island District had already carried this to extremes. They had named a quarterboat the *Hoffmann* in 1874, and later they had named a sounding machine the *J.N. Macomb.*) In October, orders from the Chief of Engineers to Major Keller changed the names of the new dredges to Hydraulic Dredges Nos. 6, 7, and 8. These same orders changed the name of the *Hecla* to Hydraulic Dredge No. 2, and the name of the *Etna* to Hydraulic Dredge No. 5.[16] The reason given for the order was "to avoid the use of strange and outlandish names for plant in this District."[17]

Photographs taken of boats during this period show that the names were removed and replaced by numbers. The full titles painted on the boats read as follows:

U.S. Engineer Department
Upper Mississippi River Improvement
Hydraulic Dredge No. 3

By July of 1911 names were again permissible, but the names for the three dredges being constructed were still in debate. In a letter to Keller, Meigs complained that Keller's suggestion of *Sucker* and *Outcast* (note the puns) were no good. Meigs felt that the names should be *Erobus, Terror,* and *Stromboli,* to keep the tradition in the District of naming dredges after volcanos.[18] Late in 1912 the dredges finally received names: *Apo, Taal,* and *Mayon*, all Phillipine volcanos. The last bit of sparring in the dredge controversy came in a tongue-in-cheek letter sent to the Chief of Engineers by C.W. Durham in 1913. In that letter, Durham wrote that he didn't see why "Hector," "Achilles," "Castor," and "Pollux" wouldn't work as names for the dredges, "since they are not the names of [Corps] officers living or dead."[19]

Although most of the dredging on the 6-foot project was on sandbars, much rock still remained to be excavated; to take care of this three new dipper dredges were built at Rock Island in 1914. The

Davenport, Keokuk and *St. Paul* were identical sister ships, each displacing 348 tons, built by the Rock Island Bridge and Iron Works using machinery from the Osgood Dredge Company. Each cost $56,663 to build. They had 2-cubic yard dippers at the end of 45-foot booms and were able to dredge in as much as 18 feet of water.

As big and expensive as these boats were, they operated with far more economy than the simple equipment of the early days of improvement work. Each of the dredges was able to dredge an average of 26 cubic yards to 90 cubic yards of sand or mud per hour at a unit cost of 0.515 cents per yard. This compared with the average of more than $9 per cubic yard paid to remove rock in 1854, and the $37 per cubic yard that Lieutenant Lee paid on the Des Moines Rapids in 1838-39.

By the end of 1914 the Rock Island District had spent a total of $2,680,795 on its fleet.

The last of the steamboats built for the Rock Island District were the four identical medium towboats, the *Le Claire, Minneapolis, Muscatine,* and *Nauvoo*, built at Grafton, Illinois, by Edward Howard in 1915. These were steel-hulled boats of 254 tons, with a length of 144 feet, 10 inches, and a beam of 34 feet, drawing 3 feet of water. Rivermen nicknamed them the "silo boats" because of their height, their tall, straight sides, and the location of the pilot house forward of its usual location.

The silo boats were designed at the Rock Island District Office, and the designs created some embarrassment among the oldtimers. After looking at the planned design, William Thompson wrote to C.W. Durham from La Crosse:

> The cabin on the towboats, as originally planned, is the rottenest thing I ever saw, and that pilot house is simply ridiculous, shoved way up forward. I showed the plan to some pilots and they all laughed at us. For the Lord's sake, cut that out and build the cabin according to Richard's [Richard Monroe, Principal Assistant Engineer in the Rock Island Office] plan. There is not a steamboatman in the world acquainted with the Mississippi River that would recommend such an arrangement. We would be the laughing stock of everybody on the river. The hull is fine and I don't see that it could be made any better, but that cabin and pilot house would be a laughable proposition if it were not so serious."[20]

The silo design prevailed, and can be seen in the illustration on page 216.

One boat which deserves special mention is the *Ellen*, the "District Engineer's royal barge."[21] The *Ellen* was built at La Crosse, Wisconsin, in 1907, and bought by the Rock Island District from the Cargill Estate[22] in 1911 for $12,000. She was an oak-hulled, 200-ton boat, 144 feet long with a 26-foot beam and a 3-foot draft. Her 18-foot stern wheel moved her along at 10 miles per hour.

The *Ellen* became the flagship of the District fleet, inspecting work in progress, taking visiting dignitaries around, and representing the Corps at dedication ceremonies for locks and dams during the 1930's. Her captain was James Maxwell, an old riverman who had earlier worked for the Lighthouse Service taking care of the 17 miles of lights along the Rock Island Rapids. "Jimmy the Lamp," as he was known then, made the trip between Rock Island and Le Claire daily in a small rowboat in order to tend the lights.[23]

All of these additions between 1900 and 1915 increased the District fleet to the point where it was by far the largest single operation on the Upper Mississippi. In 1918, when there were fewer than 80 packet and towboats left in private hands, the Rock Island District fleet numbered 19 steamboats, 8 hydraulic dredges, 5 dipper dredges, 4 gasoline screw launches, 12 small gasoline paddle launches, 48 motor skiffs, 233 barges, and 145 office boats, quarterboats, fuel flats, store boats, spudboats, buildingboats, grasshoppers, dump boats, derrick boats, houseboats, and drill boats, in addition to a full complement of lifeboats, yawls, and skiffs for each of the steamers.

In 1930 the Rock Island District received its last paddle wheel boat and its first diesel powered boat when the *Fort Armstrong* arrived. She was a medium boat, 109 feet long with a 20-foot beam, and she was powered by diesel electric drive with a chain to the paddle. In the late 1940's the *Fort Armstrong* was transferred to the Huntington Engineer

The diesel towboat *Rock Island,* 64 feet long with 850 horsepower.

District. With the coming of the new 9-foot channel, there was no longer any need for the paddle wheel.

The District fleet experienced a small spurt of new growth as the Corps prepared for the 9-foot channel project in 1930. Thirty-one new pieces of floating plant were bought or constructed in 1930, and an additional 46 pieces were contracted or built by hired labor in 1931. But most of these were smaller boats and barges designed not so much for construction as for the growing responsibility of maintenance.

With the 9-foot project done mostly by contract, the need for an extensive Government fleet disappeared. By 1937 the fleet had been reduced to three steamboats and one diesel electric towboat. There were still seven suction dredges, but only one dipper dredge and about one-fourth the number of quarterboats, barges, and launches there had been in 1918.

Two impressive pieces of equipment were added late in the 9-foot channel project. In the summer of 1937 a new highpowered hydraulic cutter-head dredge, the *Rock Island,* arrived in the District. At 230 feet long with a 48-foot beam and a 4.5-foot draft, displacing 1,500 tons, the *Rock Island* was the largest dredge the District had ever owned. Four dredges the size of the *Geyser* could be placed on her deck.

The twin-screw, 450 horsepower *Clinton* arrived in the District in 1974.

The *Rock Island* was capable of making a cut 400 feet wide in 30 to 35 feet of water. Its output when operating on 2,500 feet of floating and shore line was about 1,200 cubic yards per hour. The *Rock Island*'s hull was of wrought iron to resist deterioration.

Power for the dredge pump was supplied by a 1,000-horsepower diesel engine. Two 650-horsepower diesel driven generators supplied power for the twin screws for propulsion; these same engines furnished current to operate the cutter motor and all auxiliary machinery.

The *Rock Island* was a complete unit, with a machine shop for field repairs, quarters for 68 crewmen, recreation rooms and laundry facilities. The dredge was built by the Dravo Construction Company of Pittsburgh at a cost of $1,000,000.

She worked in the Rock Island District maintaining the 9-foot channel until 1958, when she was transferred to the St. Lawrence Seaway project. Her duties in the Upper Mississippi were taken over by a sister dredge, the *William Thompson*, operating out of the St. Paul District. The *Thompson* spends several weeks each season in the Rock Island District as needed.

A second workboat, the *Hercules*, came to the District in 1942. Aside from the towboats, this derrick boat is today the largest piece of equipment in the District fleet. She is used primarily for maintenance work on the locks and dams, being used to lift lock gates out for repair and overhaul.

Two 42-foot towboats, the *Macomb* and the *Monmouth*, were added to the fleet in 1942-43. These were 350-horsepower boats of single deck design with pilot houses eight feet above the waterline. Two additional boats of the same size were added in 1950, the *Cottel* and the *Craigel*, both 165-horsepower, single-screw boats. Of these, only the *Monmouth* is still with the fleet.

Joining the *Monmouth* and the *Hercules* since 1950 have been several modern boats. The first of

The derrickboat *Hercules* at work on a gate at Lock 26 in the St. Louis District. Operated by the Rock Island District, the *Hercules* works in the St. Louis and St. Paul Districts as well.

these was the *Rock Island*, a 64-foot towboat of 850 horsepower. In 1974 a tender, the *Clinton* was built for the Rock Island District. The *Clinton* is a twin-screw boat of 450 horsepower. Two years later another tender, the 52-foot *Muscatine* was christened at Muscatine, Iowa. The *Muscatine* is the sixth boat named "Muscatine" on the Upper Mississippi, the first being the District sternwheel steamer built in 1915.

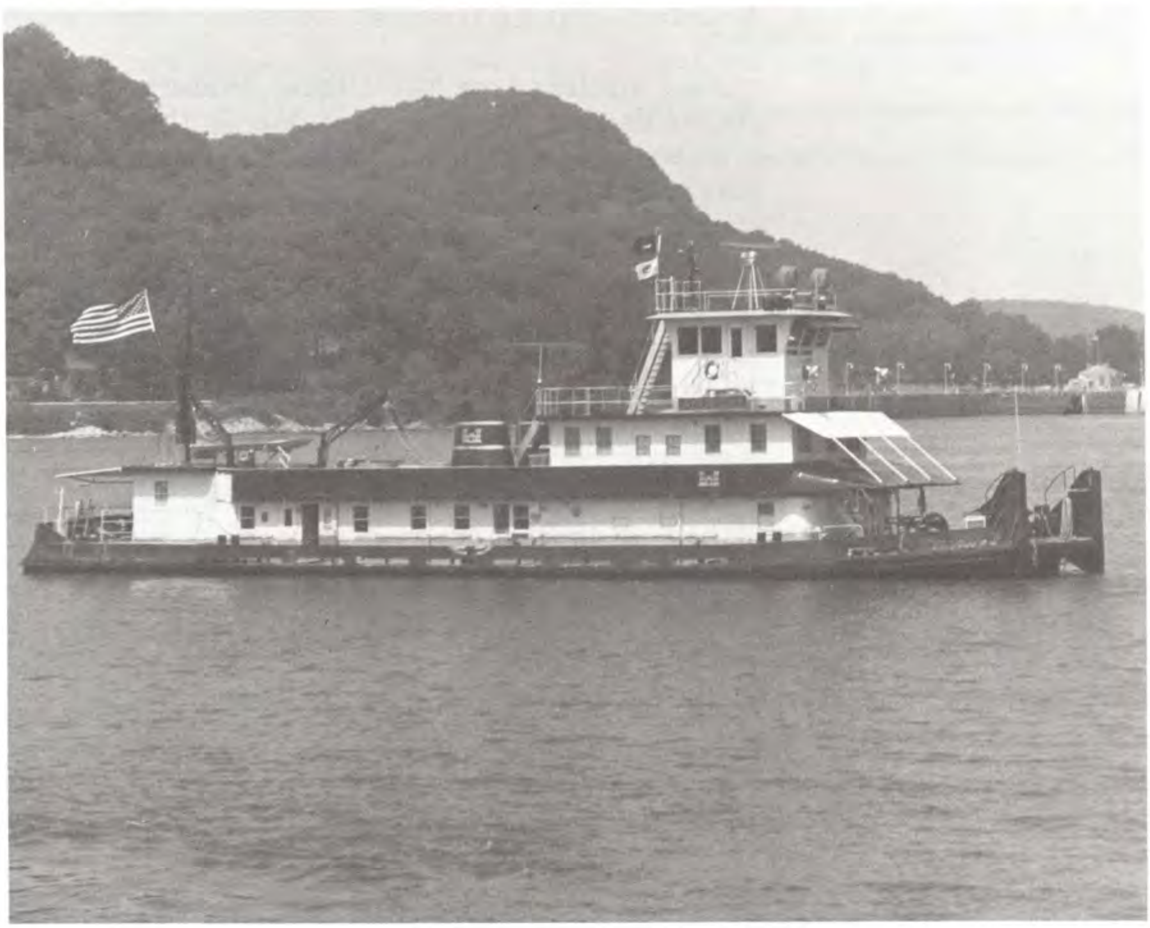
The arrival of a new boat in the District still creates excitement. Typical of this was the christening of the *General Edgerton*, a new survey boat, on Engineer Day, June 16, 1977. At ceremonies held at Locks and Dam 15 in Rock Island, the boat was

named for Major General Glen E. Edgerton, who served as Rock Island District Engineer from 1930-1933. Edgerton became Governor of the Panama Canal Zone during World War II and died in 1976.

The boat was christened by Mrs. James N. Rothschild, General Edgerton's daughter. As part of the ceremony, the Canal Zone governor's flag was raised on the boat; the flag was afterwards presented to Colonel Lycan, the District Engineer, for permanent display aboard the boat.

The most recent new boat in the District is also the largest, the *Andrews*. The *Andrews* is 120 feet long, 27 feet wide, and has a draft of 6 feet, 6 inches. She is powered by two 800-horsepower diesel engines. Originally built in 1954 for the US Army

The *Andrews*, added to the District fleet in 1980, is currently the largest boat at Rock Island. It is 120 feet long and is powered by two 800-horsepower diesel engines.



Transportation Research and Development Command at Fort Eustis, Virginia, she was transferred to the Vicksburg District Corps of Engineers in 1961, and from there, in 1980, to the Rock Island District.

Along with the transfer of the Illinois Waterway to the Rock Island District on July 1, 1980, came several additional pieces of floating plant based on the Illinois River. Based at the Corps of Engineers Joliet Project Office are two towboats, the *Channahon* and the *Kankakee*; a survey boat, the *Ranger*; and a crane barge, the *Mazon*. Based at the Corps of Engineers Peoria Project Office are two small towboats, the *Pekin* and the *Peoria*. Small towboats are also stationed at the Peoria Lock and the La Grange Lock to assist in raising and lowering the wicket gates on the dams at those places. The *Sangamon* is stationed at the Peoria Lock, the *Beardstown* at La Grange.

Also stationed on the Illinois Waterway are a steam derrick, *Derrick Boat No. 3*; the *Atlas*, a 170-ton diesel electric gate lifter; and two additional survey launches.

The Rock Island District fleet has mirrored the changes in the general picture of river transportation. The present fleet is smaller and less picturesque, but the new boats are far more powerful and efficient than the old boats. They get a lot of work done quietly.

Notes

Chapter 6

1. The annual *Floating Plant Reports* published yearly along with the *Annual Reports* until 1920 show how large the Rock Island fleet was. The *Floating Plant Report for 1918*, for example, shows the Rock Island District in possession of 199 named pieces of equipment (541 total plant) while the Kansas City District, next largest in number of floating plant, lists 45 named pieces (295 total).

2. C.W. Durham, "Memorandum," January 30, 1911, Old Rock Island File, RG77, Kansas City Federal Records Center.

3. Major G.K. Warren to Chief of Engineers, March 30, 1867, File 25, Letters Received, RG77, NA.

4. Colonel Wilson to Chief of Engineers, June 19, 1868, File 1683, Letters Received, RG77, NA.

5. Herbert Quick, *Mississippi Steamboatin'* (New York: Henry Holt and Co., 1926), p. 125.

6. Colonel Macomb to Chief of Engineers, October 6, 1877, File 71, Letters Received, RG77, NA.

7. General Gross Barnard was a graduate of West Point in 1833, 2nd in his class. He was a professionally respected engineer in both practical and theoretical circles, publishing several engineering treatises. During the Civil War he served as Chief Engineer of the Department of Washington and the Army of the Potomac. Late in the War he became Chief Engineer of the Armies in the Field under General Grant.

8. *Annual Report*, 1879, II, p. 1106.

9. William Thompson, Annual Report of Floating Plant, 1918, Old Rock Island File, RG77, Kansas City Federal Records Center.

10. *Annual Report*, 1888, III, pp. 1463ff; and 1889, III, p. 1720.

11. J.D. DuShane to Major Riche, August 7, 1907, Old Rock Island File, RG77, KCFRC.

12. C.W. Durham, Memo, May 17, 1908, Old Rock Island File, RG77, KCFRC.

13. *Ibid.*

14. Major Keller to Montgomery Meigs, September 10, 1910, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG77, NA.

15. Major Keller to Montgomery Meigs, September 19, 1910, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG77, NA.

16. Major Keller to Montgomery Meigs, October 7, 1910, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG77, NA.

17. Major Keller to J.D. DuShane, October 1, 1910, File 1652, Press Copies of Letters Sent ("General Letter Books"), EG77, NA.

18. Montgomery Meigs to Major Keller, July 17, 1911, File 1652, Press Copies of Letters Sent ("General Letter Books"), RG77, NA.

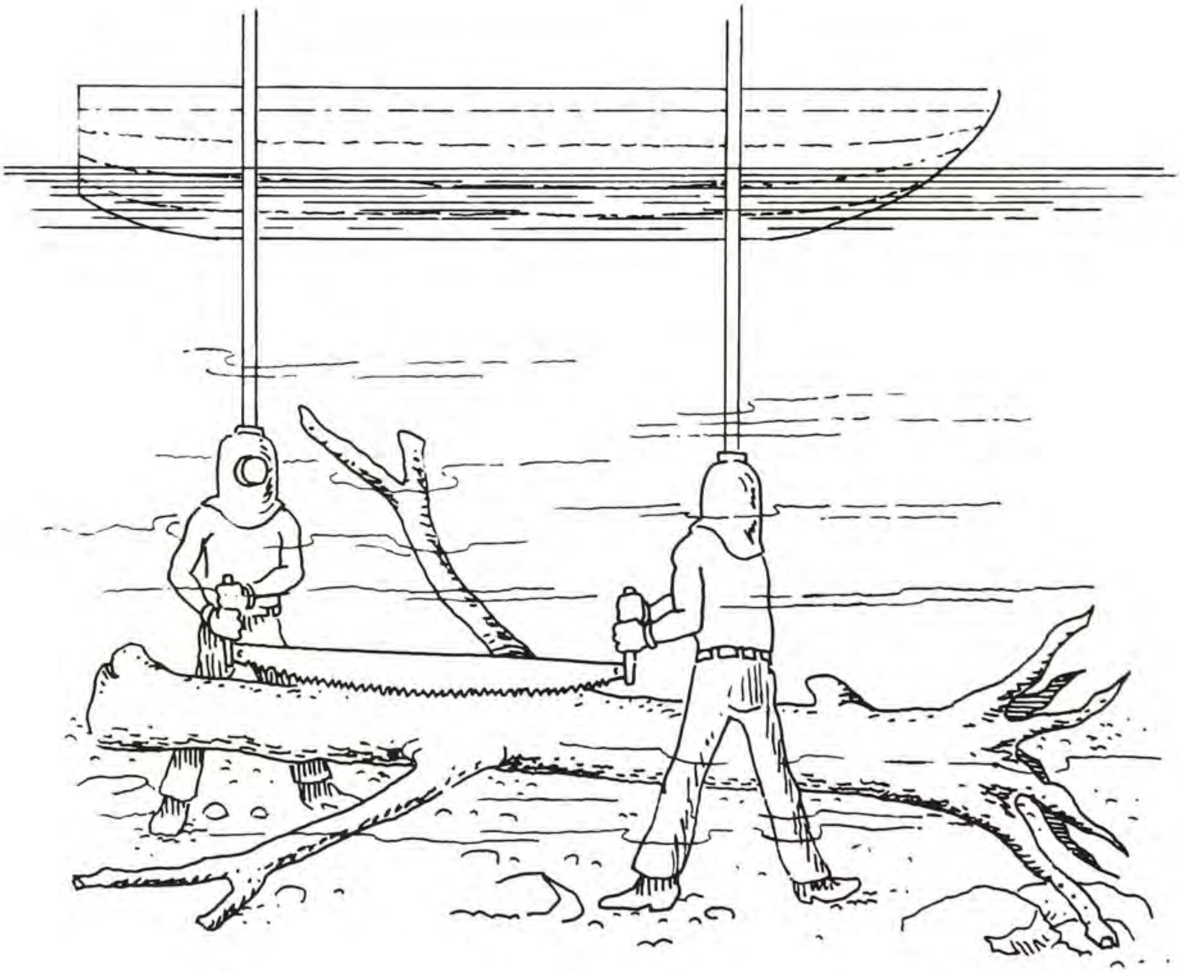
19. C.W. Durham to Chief of Engineers, January 20, 1913, File 1652, Vol. 40, Press Copies of Letters Sent ("General Letter Books"), RG77, NA.

20. William Thompson to C.W. Durham, November 12, 1913, Old Rock Island File, RG77, KCFRC.

21. Interview with Robert Clevenstine, Chief of Operations, Rock Island District, June 13, 1973.

22. Cargill is a large Minnesota-based grain concern.

23. Interview with Mrs. M.F. Weissmann, April 21, 1971.



Chapter 7

River Tinkerers

One of the perennial figures in American folklore is the tinkerer, that small-time inventor who turns bits of junk into strange but workable machines that fly or kill mice or get other jobs done. Most tinkerers are never famous beyond their own yard; others, like the Wright brothers in their bicycle shop, have tinkered their way into history.

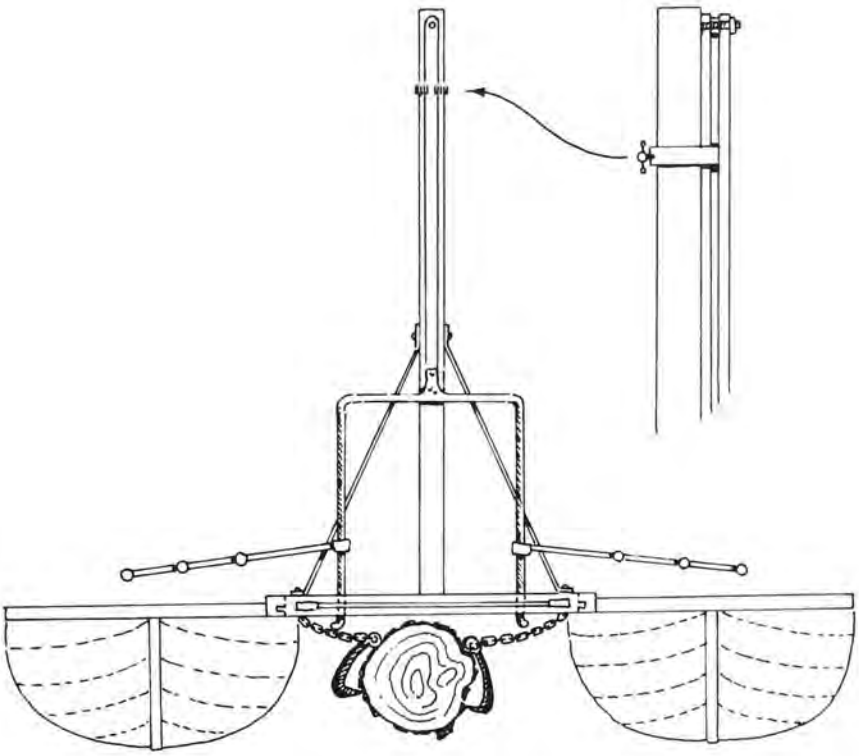
In the history of American tinkering, no group is more typical than the many rivermen who addressed themselves to navigation improvement. A very few, such as Henry Shreve, were successful. His high pressure engine designs helped conquer the Mississippi, and his snagboats made steamboat travel safer. Most tinkerers, however, lacked Shreve's imagination, and because every Mississippi pilot and riverman considered himself an expert on the topic of river improvement, the engineers of the Rock Island District constantly found themselves amused and often plagued by individuals and groups who knew how to improve the channel with less work and more economy than the Corps of Engineers.

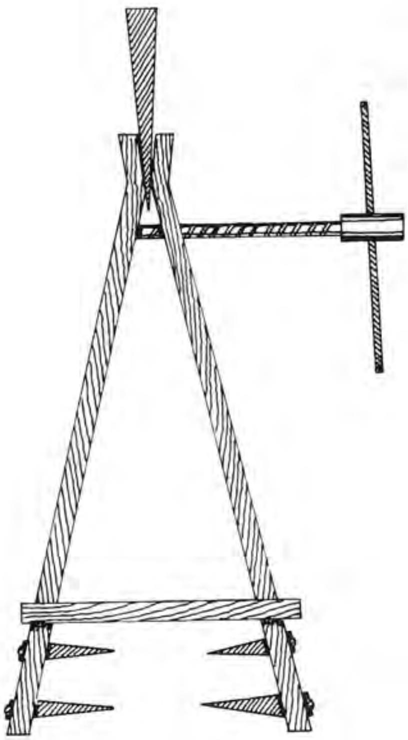
Even before the beginning of the Rock Island District, river tinkerers were at work. In 1824, the Board of Engineers appointed as a result of the General Survey Act to determine the most suitable methods of improving the Ohio and Mississippi Rivers, placed an advertisement in newspapers throughout the United States offering a reward of $1,000 for "the plan, machines, or instrument best calculated to remove sawyers, planters, and snags in the Mississippi River, so as to render the navigation free and safe."[1]

This single advertisement, placed by Chief of Engineers Major General Alexander Macomb, drew many responses, some of which were incorporated into later river work. The responses ranged from simple solutions such as blowing the snags to pieces with black powder[2] to complicated equipment such as that suggested by T.W. Parker. Parker proposed a diving bell in which to send a crew down to saw up the snags underwater, and a steamboat with a screw in the middle, run by horses on a round treadmill to run the screw into the piece of snag and pull it free of the bottom.[3] E. Blunt of New York sent in plans for a "parachute," a large sail cloth umbrella which could be tied to the snag, then opened downstream so that the current could pull the snag free.[4]

The most common suggestion involved some variation on a twin-hulled boat similar, as one respondent said, "to the Twin Ferry-boats on the River Hudson."[5] Some designs placed a winch between the two hulls to lift the snag out; others suspended elaborate underwater circular saws from the hulls to saw the snag up.[6] Benjamin Tucker sent plans for a watertight periscope to find the snags, and plans for "a dress made of caoutchouc [crude rubber] with glass set in over the eyes."[6] Two men wearing these diving suits would stand on the bottom of the river and saw the snags up with a two-man saw, breathing through tubes made of spiral wire covered with gum which ascended to a flatboat on the surface.

Other letters sent to the Board contained suggestions for handling sandbars and shoal water. W.





Wright submitted drawings of his "mud tortel," a scoop for "remooveing the sand and gravel and arth off aney Bar or Shoel or island shutes in the River of Ohio and Mississippi [sic.].[7] A. Read proposed a gang of three plows hitched together to plow out bars, followed by a large scoop to catch the loose mud.[8] Many proposed variations of wing dams. John Baxter suggested filling flatboats with stone until they sank, then planking them over. To mark the resulting channel, he proposed putting bells at the edge of the channel, rung by the motion of the water through a wheel, with one side of the channel ringing twice the rate of the other.[9] Baxter also proposed a boat that would not only pick up snags, but would saw up the wood and sell it to passing steamboats for firewood.[10] Henry Vose suggested a kind of movable wing dam consisting of a huge raft 300 by 250 feet which would be purposely stuck on a sandbar so that the river would be forced around the raft and wash away the bar.[11]

A number of the respondents offered to undertake the whole job of river improvement off Government hands and do it themselves. T.W. Parker offered to clear the 400 miles of Mississippi from the mouth of the Ohio down to the Louisiana state line of snags and other obstructions for $100 per mile.[12] John Bruce made a lump bid of $60,000 for clearing all of the Ohio from Pittsburgh to the Mississippi and the Mississippi from the Missouri River to New Orleans.[13]

There was also one suggestion among the respondents to the advertisement that the cost of removing obstructions be raised by a toll on steamboats using the waterway, an idea that was not to become a reality for more than 150 years. Edward Clark suggested that the amount of such a toll be decided by "the aggregate of property which is lost or injured in consequence of these impediments to navigation in the present condition of the river."[14]

During the remainder of the improvement work, such river tinkerers were at hand, giving advice free or offering to sell it to the Corps of Engineers. Lee, Long, Wilson, and their assistants all got such advice.

When Major G.K. Warren investigated the possible methods of clearing the channel in 1866-67, he was flooded with suggestions, several of which he mentioned in his report.[15] There was the plan of E.E. Bishop of New Orleans, whose idea was to "fix two large screws obliquely, one on each side of a steamboat's bow; these, driven by the engine, draw the boat through the water, and on striking a sandbar, throw the material on each side, making a way through it equal to their greatest width apart."[16]

A similar plan was suggested by Colonel William R. Noble of St. Paul. His invention provided "for an arrangement of two endless screws, placed on a horizontal axis at the end of the boat, and arranged to lower to the sand. The screws, driven by steam, are made to stir up the sand, and push it each way outward."[17]

Another plan Warren came across was by a Mr. Jones who, obviously influenced by adjacent farmlands, devised a plan "to drag a large plough over the bar by attaching it to the stern of a steamboat."[18]

Captain Edwin Bell, an old and respected riverman, suggested to Warren the first of what was to become a long series of inventions he proposed to the Corps, a wheel with teeth in it suspended between two boats and turned by the power of the river current. This action would be aided by scows which would lower boards along their sides to act as wing dams in channeling the current. The teeth of the wheel would churn up the sand and the current would carry it off.

Bell was regarded as something of an eccentric, though his knowledge of the river was respected. He was a steamboat captain from 1854 to 1867, when Warren hired him to supervise removal of snags on the Minnesota River. Bell convinced Warren that "sand dams" could be created to constrict a channel by lowering boards to within four inches of the bottom. The current sweeping under these board walls would scour out sand and deposit it further downstream as a dam. This would do away with the need

to build wing dams of brush and stone. Warren authorized Bell to test this invention on the Wisconsin River in 1869, and paid $400 for it. It became part of the equipment transferred to Colonel Macomb in 1870.

In the 1870's and 1880's, however, Bell's relationship with the Corps grew increasingly strained. The Corps rejected a long string of Bell devices, and in turn was accused by Bell of using his ideas without paying royalties.

A long correspondence covering the tenure of several District Engineers developed over Bell's movable wing dams, which consisted of a string of barges with wooden gates along one edge. The gates were to be lowered to the bottom of the river, forming a wall to direct the current. After that section of channel had been improved, the dam could be moved to another location. Colonel Macomb ran tests on the wing dam flats in August 1876, and convened a Board of Engineers to investigate its merits, but no action was taken.

The Corps paid somewhat more attention to Bell's contraption for building dams, which he invented after the Corps had committed itself to wing dams as the method of obtaining the 4½-foot channel. This was essentially a barge tilted so that one side was beneath the water, making it easier to position material along the dam. Major Farquhar requested permission to build and test one of these in 1878.[19]

Captain Bell's final attempt to help the Corps came in 1895 when he developed a method of removing sand from the channel and depositing it in between the wing dams that had been built. This would form new banks further out in the river so as to "make a canal in the channel."[20]

The most unusual inventor ever to have anything to do with the Rock Island District was a man by the name of Adams who, in some manner, convinced Congress in 1879 that his invention, the "Adams Flume," could quickly clear the whole channel from St. Paul to St. Louis for a fraction of the proposed

cost of the Engineers' plans. Congress appropriated $20,000 for Adams' experiments and instructed the Rock Island District to give him a test section of the river. Additional appropriations of $8,000 in 1882 and $15,000 in 1886 brought the total to $43,000. By 1886, however, Congress was beginning to listen to the reports of Colonel Mackenzie, and in 1887 the Secretary of War suspended Adams' work. The River and Harbor Bill of 1892 gave Adams a final $5,000 to give up all claims.

Colonel Mackenzie investigated the remains of the Adams Flume in 1892 at the request of the Secretary of War. He found a few sections of pipe, some sheet iron, and a 5-horsepower pump. No section of Adams' pipe had ever been in the river; apparently, Adams had never gotten around to actually testing his invention.

Adams was never very clear as to just how his flume worked. He showed it to Major Farquhar in 1877 (who tried to convince him it would never work). Basically, it consisted of a triangular pipe laid down the middle of the channel. The pipe had rows of small L-shaped jets. Adams proposed to pump water through the pipe under pressure. The water coming out of the jets would stir up the mud, sand, or gravel, and the current would wash it away. In a letter to the chairman of the River and the Harbor Committee in 1886, Adams claimed that "to lay it in one unbroken line in the center of the river from its head to the Gulf will scour a channel the necessary depth and width throughout and keep it open all through."[21] Adams had counted on one small pump every 100 miles to power the operation.

Outsiders were not the only tinkerers on the Upper Mississippi. The Engineers themselves proved to be innovative in their development of methods and equipment to improve the river. Lee's drilling rigs at the Des Moines Rapids, the design of snagging and dredging equipment suited to the Upper Mississippi's sandy bottom, Wheeler's use of Portland cement on the Illinois and Mississippi Canal, and Farquhar's steam scows were all results of trial and error in the field.

Engineers like Montgomery Meigs were natural tinkerers. Meigs used the excess steam from the Des Moines Raids Canal lock operations to heat the Keokuk Engineer Office; he experimented with adapting garden squirts as boat pumps; and throughout his career with the Corps he tinkered with boats and engines. He was perhaps the only man to redesign a dredge hull "for just a bit more speed." One of Meigs' inventions used on many subsequent projects was a canvas coffer dam developed for the Des Moines Canal project. This permitted engineers working on locks to circumvent the normal crib cofferdam.

Another inventive assistant engineer in the Rock Island District was E.F. Hoffmann, who supervised the Rock Island Rapids improvement work. In 1868 Hoffmann perfected a model of a diving bell to be used for raising stone, but money for a full-sized model, though requested, was never appropriated. Hoffmann also developed a moveable cofferdam and a tamping machine for exploding mines and dynamite.

The most useful of Hoffmann's devices was a self-registering sounding machine developed in 1874 along the lines of the one developed a few years earlier for the Illinois River survey. This machine allowed a tremendous increase in the number of soundings a survey crew could make. The machine was installed on a barge and towed by a steamer. Its operation was described in the *Annual Report* for 1875:

> The self registering sounding machine which is pushed by a small steamer and worked by the capstan of the boat, covers a width of 100 feet, upon which 10 sounding poles are fixed, which descend simultaneously and perpendicularly at option from one to six times per minute, so that from 10 to 60 soundings in that time can be made and recorded. In practice, 40 soundings per minute is the maximum, because the observers of theodolites on shore are unable to read with accuracy more than four bearings in a minute. The machine saves, when in use, 10 men with poles and 10 recorders, and the recording apparatus throws out very distinctly and accurately the profile of the river bed. The depth to which the poles descend is 14.5 feet. It could be increased to 20 feet in depth with attached pieces to the poles.[22]

This machine became so much a part of the equipment in the District that it was eventually given a name, the *J. N. Macomb*.

Today, editorials and letters to the editors in newspapers along the Upper Mississippi show that tinkering has not disappeared. A sunken barge, a flood, an ice jam, and low water — all of these bring the tinkerers out to advise the Corps on what to do; and just as before, the suggestions range from the carefully-thought-out plan to the listen-to-this-one variety. The Rock Island District still has its own tinkerers, too. The Mississippi is always full of new tricks and will continue to require tinkering.

Notes

Chapter 7

1. "Plans for Removal of Obstructions From the Mississippi and Ohio Rivers," File 252, RG77, NA.

2. Letter of C.L. Rackwood to Secretary of War, August 13, 1824, File 252, RG77, NA.

3. T.W. Parker to Secretary of War, August 12, 1824, File 252, RG77, NA.

4. E. Blunt to John C. Calhoun, June 19, 1824, File 252, RG77, NA.

5. N. Hunt, no date, File 252, RG77, NA.

6. Allen Fitch, June 28, 1824, File 252, EG77, NA.

7. W. Wright, no date, File 252, RG77, NA.

8. A. Read to Secretary of War, August 29, 1824, File 252, RG77, NA.

9. John Baxter to Major General Alexander Macomb, June 10, 1824, File 252, RG77, NA.

10. *Ibid.*

11. Henry Vose to Secretary of War, September 8, 1824, File 252, RG77, NA.

12. T.W. Parker to Secretary of War, July 28, 1824, File 252, RG77, NA.

13. John Bruce to Secretary of War, August 31, 1824, File 252, RG77, NA.

14. Edward Clark to Secretary of War, August 16, 1824, File 252, RG77, NA.

15. U.S. Congress, House, *Letter from the Secretary of War in Answer to a Resolution of the House, of December 20, 1866, Transmitting Report of the Chief of Engineers, with General Warren's Report of the Surveys of the Upper Mississippi River and Its Tributaries*, Executive Doc. 58, 39th Congress, 2d Session, 1867.

16. *Ibid.*, p. 27.

17. *Ibid.*

18. *Ibid.*

19. Major F.U. Farquhar to Chief of Engineers, August 6, 1878, File 71, Letters Received, RG77, NA.

20. J.D. DuShane to Colonel W.R. King, August 22, 1895, File 1652, Vol. 6, Press Copies of Letters Sent, RG77, NA.

21. *Annual Report*, 1888, III, p. 1512.

22. *Annual Report*, 1875, I, p. 466.

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Chapter 8

The Decline of River Traffic and the 6-Foot Channel

Critics of the Corps of Engineers have pointed with irony to the fact that as the Engineers of the Rock Island District continued to improve the river, traffic on it continued to decline. They have suggested that the methods adopted by the Corps were wrong, that the work done was too small to make a difference, and came too late, or that river improvements were futile and expensive attempts to artificially keep alive an older form of transportation whose decline was natural and inevitable.

At least one District Engineer supported these views. Colonel Curtis McD. Townsend, District Engineer at Rock Island from 1898 to 1903, felt that the decline of river traffic was "due to natural law."[1] He felt that the river had had the advantage when animal power (such as a team of horses) was used for both land and water transportation. A team of horses could haul 200 tons on a canal boat, but only 10 tons over steel rails. But steam power and later engines made power relatively unimportant. At this point, Townsend felt, railroads had the

advantage because they could be put down wherever the need was, while water routes never really coincided with commercial routes.[2]

What happened to commercial traffic on the Upper Mississippi between 1890 and 1920 was much more complex than such critics would suggest. In fact, although it is usual for accounts of this period to talk about a decline of traffic, there was not so much a decline in use of the river as a shift in the pattern of use. The towboat and its barges are often snowed under by the dramatic and real figures which marked the end of the lumber industry.

Lumber. The moment of glory on the Upper Mississippi was undoubtedly the period from 1875 to 1915 when millions of board feet of logs and lumber floated down the river to markets and sawmills as far south as St. Louis. Logging was the largest industry in the Upper Midwest, and it made its impact felt not only on the economy but on the shape and size of bridges along the rivers, and on the kind of improvement engaged in by the Rock Island District Engineers. In determining the amount of curve a bend could have or the shape of a channel crossing, Engineers had to pay attention not only to the maneuverability of a 300-foot packet, but to the far less maneuverable log or lumber raft which might be 300 feet wide and 1,500 feet long.

Lumbering had already become a part of the Upper Mississippi economy when Colonel Wilson arrived in 1866, but by 1878 it was dominant. More than 100 steamboats were employed in rafting. That year 863 log rafts passed the Winona Bridge. The 73 sawmills between the mouth of the Chippewa River and St. Louis had a sawing capacity of 600,000,000 board feet per day.[3]

The lumber industry remained remarkably steady, reaching a peak in the early 1890's, even though the forests were rapidly giving out. Between 1,100 and 2,100 rafts passed the Winona Bridge each year between 1890 and 1899, variations in the number being due almost entirely to the depth of

water in a given year. In 1899, within 10 years of the virtual end of logging in northern Minnesota and Wisconsin, sawmills manufactured 2,120,562,000 board feet of lumber and 619,901,000 shingles, with a total value of about $32,000,000. During 1899, 86 sternwheel raftboats were engaged in moving logs. During this same year, only 16 packet boats and 35 pleasure boats operated on the Upper Mississippi.[4]

Beginning in 1900, rafting declined rapidly. By 1902 only 75 raftboats remained; the following year 70 were left. In 1904, 50 boats towed rafts; by 1906, 20. In 1913 four raftboats remained, and by 1915 these had disappeared.

Prior to the Civil War, rafts were simply strings of logs tied together and floated down the river, steered by raftsmen with poles and long sweeps. The crew lived on the raft, cooking in the open and sleeping in a cabin built at the stern. By the time the Rock Island District was established, bridges and increased steamboat traffic made such natural locomotion unsafe, and sternwheel boats were used to push the rafts downstream and provide some guidance. Later, when even more bridges and the narrow, improved channel at the Rock Island Rapids and the canal at Keokuk were built, a bow boat was added to aid steering. The bow boat was a small steamer tied sideways to the front of the raft in such a way that it could move the raft to the right or left.

Locking through the Des Moines Rapids Canal was often a day-long operation for these log rafts, since the strings of the raft had to be separated to fit the lock chamber. Rafts from the Chippewa River (made up at Beef Slough) were composed of six "strings" each 40 feet wide, while those coming down the St. Croix River (made up at Stillwater) were four strings wide, with each string being 60 feet in width. A Beef Slough raft 600 by 240 feet required 12 lockages through the canal, while a Stillwater raft of the same size required eight lockages because it utilized the dimensions of the lock chamber better.

One problem which rafts caused to other navigation was loose logs floated from the tributaries into sloughs or chutes of the Mississippi to be made up into rafts. These loose logs became a special problem in the 11 miles of river from the mouth of the Chippewa downriver to West Newton Slough. Formerly, these logs had floated into Beef Slough, but that was closed by sandbars in 1890.

Mediating between logging and packet interests became one of the touchy responsibilities of the District Engineers at Rock Island.[5]

The 1900 River and Harbor Bill stated "that it shall not be lawful to float loose timber and logs, or to float what is known as sack rafts of timber and logs in streams or channels actually navigated by steamboats in such a manner as to obstruct, impede, or endanger navigation." Lumber interests, as might be expected, tried to get this amended, and they met with some sympathy from the Rock Island District engineers. Logging interests, they felt, were the most important of any on the river.[6]

Sympathy for logging interests, however, did not always mean friendly relations. When the Corps in 1889 refused to dredge the blocked opening of Beef Slough, the Weyerhaeuser Mississippi River Logging Company responded by blowing up a Government dam across the entrance to West Newton Slough in order to use that area to tie up logs from the Chippewa River. Major Alexander Mackenzie took the company to court, but dropped the case after two years when it got nowhere.[7]

The Decline of Commercial Traffic. The Golden Age of steamboating on the Lower Mississippi came in the 1840's and 1850's — an age of the huge sidewheelers, the showboats, the floating palaces. A decline for these "monuments to human ingenuity"[8] had already set in before the Civil War.

On the Upper Mississippi, however, the real flood of immigration, industry, and manufacturing came immediately after the Civil War. This expansion

was such that river traffic thrived in spite of the difficult and dangerous conditions on the river and competition from railroads crossing the river and spreading up and down each side. The St. Louis Merchant's Exchange in 1874 reported 1,063 steamboat arrivals from the upper river, but only 752 boats from the south and 104 from the Missouri River.[9] The primary commodity on board was grain and produce, but ranged from hogs and horses to malt, wines, cement, and grease. A list of manufactures shipped from Moline, Illinois, in 1879 shows agricultural implements (mainly from the John Deere factory) worth $2,850,000, followed by wagons, malleable iron, paper, scales, pump organs, lumber, shingles, lath, pails, washboards, churns and tubs.[10]

Steamboat traffic remained at a high level throughout the 19th century. In 1879, 3,760 steamboats passed the Winona Bridge. The number rose to 4,593 in 1880, and ran between 4,000 and 5,400 until 1894, when it dropped back to 3,700 boats. A few boats on the Upper Mississippi were beginning to use barges to increase their capacity, but the highest number of barges through the Winona Bridge during these same years was 1,600 in 1887.[11] The tonnage carried by these boats was 2,300,011 tons in 1878, the year the 4½-foot channel project began. The tonnage reached its peak in 1895, when 6,051,786 tons were registered. By 1907 the figures had dropped back to 3,919,440 tons. However, those figures are somewhat misleading; they include lumber and log rafts, and much of the decline between 1895 and 1907 in these figures was due to the loss of the raft traffic.

Low water also did much to affect river traffic. The decade of the 1880's had been one of high water, but during the 1890's low water occurred throughout the Upper Mississippi River. During the extremely low water of 1894, Colonel Mackenzie reported that he could buy any boat in the river cheaply. In the 1880's a boat with crew could be rented for $60 to $100 per day. By the mid-1890's a boat, crew, and all meals rented for $30 per day.

From 1900 on, the raw statistics show a decline both in freight and in the total number of boats. What these figures don't reveal is that this decline was primarily in lumber and raft boats, and that the decline of other cargo was really a decline only in long-haul freight. The logs ran out, and the railroad took away the long-haul business, affecting waterways such as the Illinois and Mississippi Canal, but short-haul carriers actually increased.

What happened, rather than an out-and-out decrease, was a shift from the larger and more glamorous long-haul packetboats to smaller short-haul workboats hauling sand, gravel, coal, and other bulk commodities short distances up and down the river. From 1880 to 1908, freight carried by the various packet lines (long-haul) did decline from 567,180 tons in 1880 to 66,255 tons in 1908, a dramatic decrease. But during this same period the local and short distance freight hauled on the Upper Mississippi increased from 197,922 tons in 1880 to 1,783,470 in 1908. Traveling short distances, these small boats did not always pass the "Winona Bridge" or any other bridge where they were counted officially. By comparison, with another waterway, the average yearly tonnage hauled on the Illinois River in this same period was 22,500 tons.

While the raft boats disappeared completely during this period, the number of towboats and packets actually increased. In 1899 there were 16 packets operating on the river. By 1913 this had risen to 20 packets and 40 towboats. The number rose to 22 packets and 56 towboats by 1915, a year in which traffic records were broken in every division in the Rock Island District, except for the section between Hannibal, Missouri, and the mouth of the Missouri River. (The decrease in this division was due to abandonment of a sand and gravel plant at Hannibal.)

Passenger traffic, too, held up much better than later accounts suggest. The number of passengers carried by all boats in 1915 was 2,008,560. This included 779,683 ferry passengers, but even the remaining number is substantial.

Here again, however, long-range packet service did suffer. By 1918 there were no longer any packets running between St. Paul and St. Louis. All that remained was one short-line boat from Rock Island to St. Paul, one between Rock Island and Quincy, Illinois, and one from Quincy to St. Louis. With the passing of the large packets, the glamour disappeared from the river, but the work remained, shifting to less exciting, small gas and steam launches with barges. By 1920 the five large passenger packet boats remaining on the Upper Mississippi had all been converted into excursion boats without overnight accommodations.

Shipping of all types on the river did fall off rapidly during World War I, due partly to the difficulty of getting crews. When the economy recovered after the War, industry had lost the habit of shipping by water, and river traffic remained low. In 1925 the Inland Waterway Corporation began a campaign to re-introduce the Mississippi to the Nation, and the decline in river traffic, though never as great as popularly imagined, stopped, and shipping began a slow climb back up.

The 6-Foot Channel

As the 4½-foot channel neared completion with construction of the Moline Lock, it became clear to both river interests and Congress that the shift in river traffic to barges, and the increasing competition from railroads meant a deeper channel was needed if the Upper Mississippi were to remain competitive. Further, it had always been the intention of Congress to increase the 4½-foot channel to 6 feet at some future date. Accordingly, the River and Harbor Act of March 3, 1905, provided for an estimate to be made for securing a 6-foot channel.

Impetus for renewed work on the Mississippi came from the railroad crisis of 1906. Until then railroads had been able to handle nearly all of the produce and merchandise to and from Midwestern farmers. That year a record crop throughout the Midwest overburdened the railroads and left them

with too few freight cars to move the harvest. Even the railroad man James J. Hill suggested making more use of the waterways.[12] As a result of this crisis, a St. Louis convention in November of 1906 formed the Lakes-to-Gulf Deep Waterway Association. They sent a representative committee to Washington to urge President Theodore Roosevelt and Congress to create a commission to draw up a plan for comprehensive, basin-wide improvement of the inland waterways. This petition was seconded by every important river town along the Mississippi, and on March 14, 1907, President Roosevelt formed the Inland Waterways Commission.

The Commission of nine members with representatives from the Corps of Engineers, conservation groups, and others interested in river planning, began active work in the spring of 1908 by taking a trip down the Mississippi. Roosevelt went along with the group from Keokuk to Memphis, occasioning the largest steamboat parade in history.

Meanwhile, the Act of March 2, 1907, authorized the 6-foot channel, to be done by wing dams, dredging, and additional locks. The 6-foot channel, however, was more complicated than merely digging the 4½-foot channel deeper. Not only would the project cost an estimated $20,000,000 over a 10-year period, it would have further effects on the shape of the river. The 4½-foot channel project had been a single-purpose improvement limited to navigation concerns, but in establishing the Inland Waterway Commission, Roosevelt wrote, "It is not possible to properly frame so large a plan as this for the control of our rivers without taking account of the orderly development of other natural resources."[13]

In addition to dredging and new locks, the Rock Island District estimated that the 6-foot channel would need an additional 2,000 wing dams, 100 to 300 feet long, and 130 miles of bank revetment.

Two locks were projected as part of the improvement. The first of these was at the Des Moines Rapids Canal at Keokuk. For many years the canal had performed well, exceeding expectations. During

high water a steamboat could make the trip down the rapids in less than forty minutes, compared to one and one-half to two hours needed to travel the canal, but the dangers of the natural channel, especially at night, outweighed the time advantage and 85% of boats coming down the river used the canal. Up river, against the current, boats almost always preferred the canal. Only the massive log rafts floating down river found the canal difficult. They had to be broken up and reassembled below the canal, a procedure that often took 40 or 50 hours.

The beginning of the end for the Des Moines Rapids Canal came shortly after the turn of the century when the Keokuk and Hamilton Water Power Company requested permission of Congress to build a dam across the Mississippi at Keokuk to generate electricity. As part of its project, the power company proposed to replace the three locks of the canal with a single lock at the dam site. This new lock, with a lift of 40 feet, would be turned over to the Corps of Engineers after completion.

Such a dam across the Mississippi marked a serious shift of direction for navigation improvement. Several earlier dams had been proposed at various locations but none had ever been built. Bridges had caused much interference with navigation, but in 1900 the entire length of the Mississippi below Minneapolis was free of dams. On the other hand, the lock and dam proposed by the power company would fit nicely with the 6-foot channel then being proposed.

The River and Harbor Act of June 13, 1902, authorized a survey of the Mississippi at Keokuk "to determine whether a dam constructed at the foot of said rapids would be a benefit or impediment to the navigation of said river." The subsequent detailed and careful examination and report by Montgomery Meigs was favorable to the project. Meigs' investigation of the potential effect of the dam showed that it would slow down the boats (15% of the total) that by-passed the canal and went directly over the rapids, and it would prove a hardship to rafters

(who were clearly coming to an end anyway in 1902—there was only one sawmill left below Keokuk), but that it would save time for a vast majority of the river traffic. Meigs estimated that between 1890 and 1901, a single lock at Keokuk would have saved a total of 12,000 hours over the three locks of the canal, a savings of $\frac{9}{10}$ of a cent per ton of freight.[14] In addition, the pool created by the new dam would flood the entire Des Moines Rapids, cutting both time and expenses by 20% over the canal.

Meigs held a meeting at the Keokuk Engineer Office on April 24, 1903, to receive objections to the proposed lock and dam, but there were none. Local residents and commerical interests all favored the plan.

In 1905 Congress authorized the Keokuk and Hamilton Water Power Company to proceed with the design and construction of the project. The Corps of Engineers made several changes in the original bill permitting construction of the dam. They added a dry dock to be constructed at the power company's expense, and provisions that the company provide free power to operate the locks and dry dock, and that the company construct suitable fishways as might be required by the United States Fish Commission. The lock was to be of sufficient dimensions to meet the requirements of an improved 6-foot channel, preliminary examinations for which were also authorized in 1905.

Part of the agreement with the power company stipulated that there be no delay of navigation during construction. In the end, the company paid damages to one packet company for the loss of one week.

From the beginning, relations between Government and power company employees were both cordial and helpful. Montgomery Meigs and Hugh Cooper, chief engineer of the project, worked together to avoid obstruction to navigation and to consider all the varied river interests in their planning.

Actual construction began in January 1910. Throughout the project, two complete crews worked, one from the Illinois side building the dam, and the other from the Iowa side building the dry dock, the lock, and the power house. For three years the dam slowly grew across the river, a cofferdam to keep the construction site dry proceeding just ahead of the work.

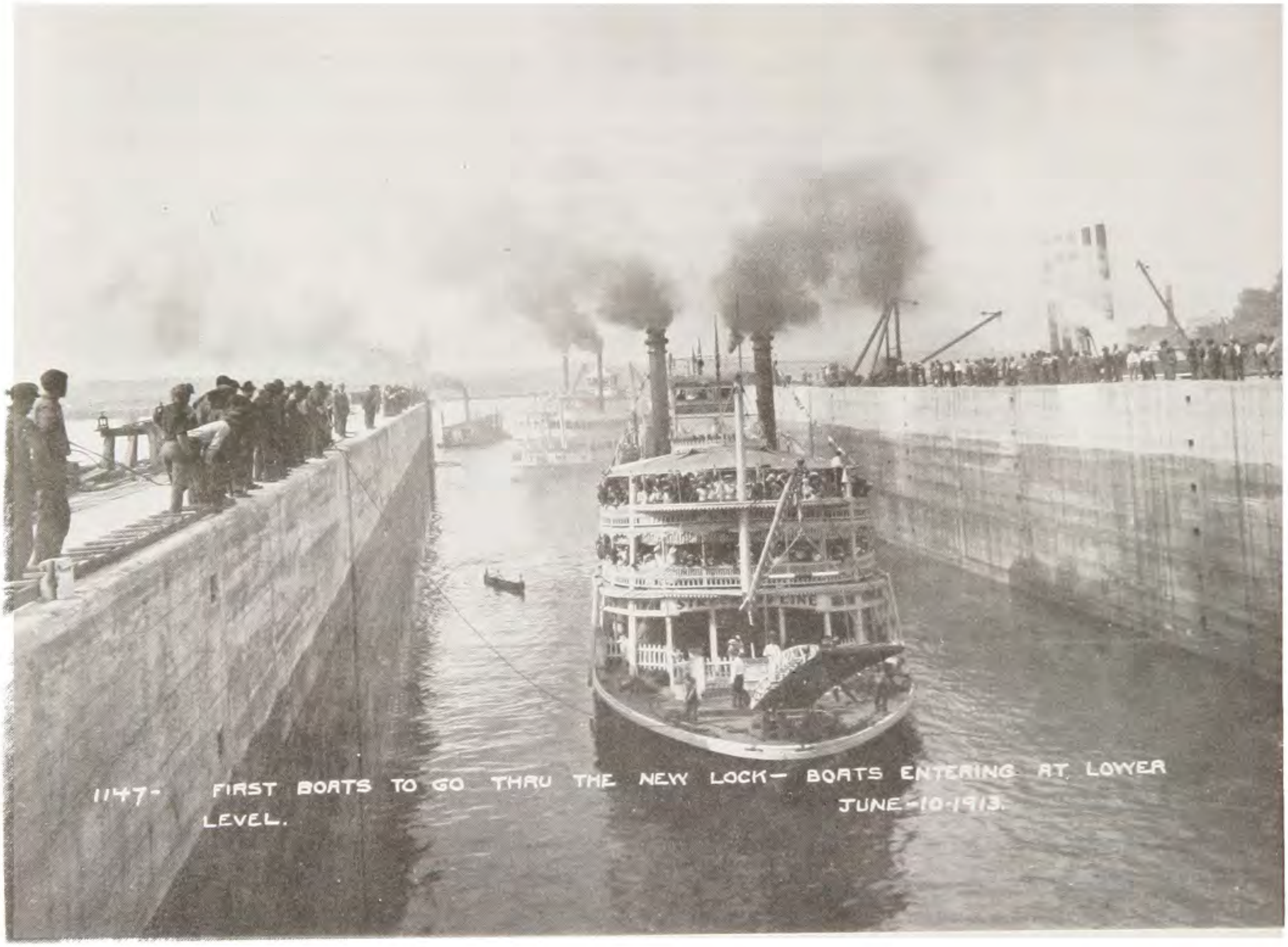
Construction on the Iowa side was more complicated because it involved a number of projects, and because the canal had to be kept open to navigation. One of the first steps was the construction of a 90-foot temporary drawbridge across the canal just north of the lower lock to permit access to the worksite for workmen, train tracks, and other heavy equipment. This bridge was completed in March 1911.

At both the Iowa and Illinois sites, workers' camps were built along with warehouses and construction yards. At each site, work crews built a rock crusher plant and a concrete mixer plant designed to put out 1,500 cubic yards of concrete a day. Sand for the concrete was pumped out of the Des Moines River, while quarries for rock and cofferdam material were opened along each shore.

Construction on the Iowa side began in the spring of 1911 with the powerplant. A cofferdam surrounding 23 acres was built out from the canal embankment. Here work on the powerplant and lock progressed during 1911 and 1912.

By the middle of 1912 the dam was three-quarters of the way across the Mississippi. At its peak, the project employed 1,200 men and used three steam shovels, five derrick cars, 30 dump cars, and 15 locomotives operating over 20 miles of track.

In order to make way for the final stages of construction, Government employees closed the Des Moines Rapids Canal for good on October 31, 1912. The lower lock and lock grounds were then gradually filled in with waste from the new dry dock excavation immediately east of the lower lock. A sea



The *G. W. Hill* and the *Sidney* become the first boats to go through the new lock on June 10, 1913.

wall was built from this new dry dock across the canal to the Iowa shore. By the time the dry dock was completed in 1914, the lower lock of the canal lay under nearly 50 feet of fill.

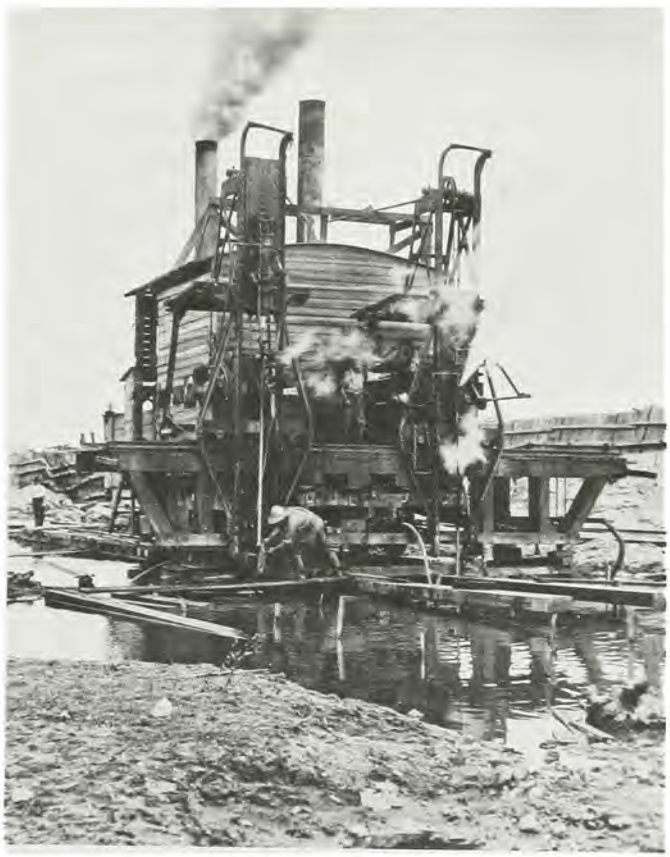
The last concrete was poured in the dam in May of 1913. On May 31, the company, now called the Mississippi River Power Company, held a locomotive parade across the new dam from Illinois to Iowa.

The completed lock was turned over to the Government late in the spring. On June 12, 1913, Rock Island District employees opened the new lock with little fanfare, 18 days ahead of schedule. The first boats into the lock came up river: the *Sidney* of the Streckfus Line, with Captain Streckfus and 405 passengers on board, and the towboat *G. W. Hill.* Montgomery Meigs sent a wire to Major Keller at

Rock Island: "The *Hill* and *Sidney* first boats through at nine A.M. Five hundred people on boats. Operation of locks perfect, twenty minutes with partial gates. Water at five nineteen eighty. We are breaking the blockade as fast as possible."[15]

In all ways, the new lock was an improvement over the canal locks. The 90-foot width authorized by Congress had expanded to 110 feet, and the 400-foot length provided a minimum depth of 7 feet over the lower miter sill at extreme low water, and a lift of 40 feet. Traditional miter gates were used at the lower end of the lock, but both lock and dry dock used floating gates that submerged to permit access from upstream. Filling and emptying were by gravity, through culverts in the lock walls and beneath the lock floor. The power company estimated the cost of the lock at $640,000.

The new dry dock was finished in the spring of 1914, complete with a sawmill, lumber shed, ice house, storehouse, and shops.



A drill car at work on construction of the Le Claire Canal, the first such machine built in the United States.

Opening day ceremonies at the new Le Claire Canal and Lock, built at the head of the Rock Island Rapids as part of the 6-foot channel project.

The Mississippi River Power Company installed lights at the lock grounds providing free power to run all the machinery, giving Meigs and his staff 20 times the light and power that had been available at the old canal.

For the next 17 years the Keokuk lock and dry dock performed well. The lock was larger in all dimensions than the two other locks in the Rock Island District: the Moline Lock and the new Le Claire Canal Lock, completed in 1922. Its size was increasingly justified by river traffic, which began to increase after the period of decline in the early 1900's.

The Keokuk Power Dam provided navigation with an additional benefit. On November 11, 1916, the Mississippi River Commission boat *Mississippi* ran aground on a sandbar 6 miles below the dam. The dam gates were opened for an hour, giving the *Mississippi* a "flash" of 2½ feet, floating her off the bar.

The Le Claire Canal. The second lock to be constructed as part of the 6-foot project was a lateral canal around the Rock Island Rapids at Le Claire, by-passing the upper 3.6 miles of rapids. There was already a 200- by 4-foot channel through this chain,

but it was very crooked. In fact, aside from the section of rapids improved by the Moline Lock, the whole Rock Island Rapids posed a major problem for the 6-foot channel. Some improvement of the rapids had been attempted after the construction of the Moline Lock, but without much success. In 1910 eleven underwater sills were built in the deeper pools below the Duck Creek Chain, 500 feet apart, rising to within 6 feet of the surface at low water. It was hoped that the sills would hold back the water and increase the depth over Duck Creek Chain, but at most, the increase in depth amounted to six inches.[16]

The Le Claire Canal project was authorized on March 5, 1914. The canal, with a low, longitudinal wall upstream, would give 6 feet of water from Le Claire to the Hampton Pool.

Maps for a lateral canal on the rapids had been drawn by a Board of Engineers in 1888, but the Board did not specify on which side of the river the canal should be built. Engineers for the 6-foot project decided on the Iowa side for several reasons. The existing improved channel was on the Illinois side. Building a canal there would interrupt navigation during construction. A canal on the Iowa side would also be ½-mile shorter. Finally, on the Iowa side engineers could made use of Smith's Island, a long narrow strip of land close to the Iowa shore, as part of the dike. Using Smith's Island as part of the dike and canal wall would save nearly one mile of construction. The total length of the dike, including the island, was to be 3½ miles. The locks were designed with an 80- by 350-foot chamber.[17]

Before any construction could begin on the Le Claire Canal, war interrupted District activities. Other than greatly reducing work on the 6-foot channel because of the scarcity of hired labor, World War I caused only minor changes in the District. Military guards were established at the Keokuk Lock in 1917 to prevent possible sabotage, and the lock was declared off-limits to visitors.

There was one very minor spy scare in the District. On March 30, 1917, District personnel caught

a young man sketching and photographing the Illinois and Mississippi Canal above Milan. The young man claimed to be a student at the University of Chicago working on a Master's thesis. Students were suspect even then, however, and District Engineer Hoffman wrote to the president of the University of Chicago to verify the student's story.[18]

World War I did bring back Major General Alexander Mackenzie to serve as District Engineer. General Mackenzie had retired as Chief of Engineers. He arrived in Rock Island on May 12, 1917, and served until June 1, 1919. During this wartime period, Mackenzie also served as Division Engineer of the Northwest Division. He carried out the official work of that office from Rock Island.

Following the war, on December 31, 1919, that section of the Rock Island District from the mouth of the Wisconsin River to St. Paul was transferred to the St. Paul District. This left the District with one major project, the Le Claire Canal. In addition, work on the wing dams continued. To bring the channel up to 6 feet, old dams had to be brought up to a grade of 4 feet above low water down to Quincy, and 6 feet above low water from Quincy to the Missouri River. Many new dams also had to be built.

Construction of the Le Claire Canal began in 1921. The project was opened to navigation (though not yet complete) in November of 1922. The final dimensions of the lock chamber were 80 by 120 feet, with a low water depth of 8 feet at the upper sill and 7 feet at the lower sill. By June 30, 1924, the project was 92% complete, and cost $20,040,632.78,[19] just over estimate.

Work went well on the 6-foot channel during the 1920's, even though appropriations by Congress never reached the $2,000,000 per year anticipated by the Corps when the project began in 1907. By August 1, 1928, when the section of the Upper Mississippi between the mouths of the Illinois and Missouri Rivers was transferred to the St. Louis District, the Rock Island District had nearly completed

the work on its portion of the channel. In the 423 miles of river within the new limits of the District, only an aggregate of about 35.5 miles of channel was less than 6 feet deep and remained to be completed.[20] By 1930 when the 9-foot channel was authorized, the 6-foot project was 82% complete. Since its beginning in 1866, the Rock Island District had spent a total of $20,018,042.37 on improving navigation on the Upper Mississippi River.

Notes

Chapter 8

1. Colonel Curtis McD. Townsend, "Decline of Water Transportation on Western Rivers," United States Army, Corps of Engineers, *Professional Memoirs*, II (1910), p. 27.

2. *Ibid.*, p. 20.

3. *Annual Report*, 1878, I, p. 705.

4. Information in this and the following paragraph is from the *Annual Reports*, 1890-1915.

5. A full account of the role played by the Corps of Engineers in the long conflict between lumber interests and other river navigation can be found in, Raymond H. Merritt, *Creativity, Conflict & Controversy, a History of the St. Paul District U.S. Army Corps of Engineers* (Washington: Government Printing Office, [1980]), Chapter 7, pp. 253-296.

6. Colonel Townsend to Chief of Engineers, March 3, 1900, File 1652, Vol. 10, Press Copies of Letters Received ("General Letter Books"), RG77, NA.

7. Merritt, p. 269.

8. Edward Clark to Secretary of War, August 16, 1824, File 252, Plans for Removal of Obstructions From Mississippi and Ohio Rivers, 1824-25, RG77, NA.

9. *Annual Report*, 1875, I, p. 473.

10. *Annual Report*, 1880, II, p. 1489.

11. *Annual Report*, 1895, II, p. 2107.

12. Julius Chambers, *The Mississippi River and Its Wonderful Valley* (New York: Putnam's, 1910), p. 231.

13. President Theodore Roosevelt, quoted in Norman Wengert, "The Politics of River Basin Development," *Law and Contemporary Problems*, XXII (Spring 1957), 267.

14. "Report of Mr. Montgomery Meigs, U.S. Civil Engineer," *Annual Report*, 1916, II, p. 1509.

15. Montgomery Meigs to Major Keller, June 12, 1912, Rock Island District Files.

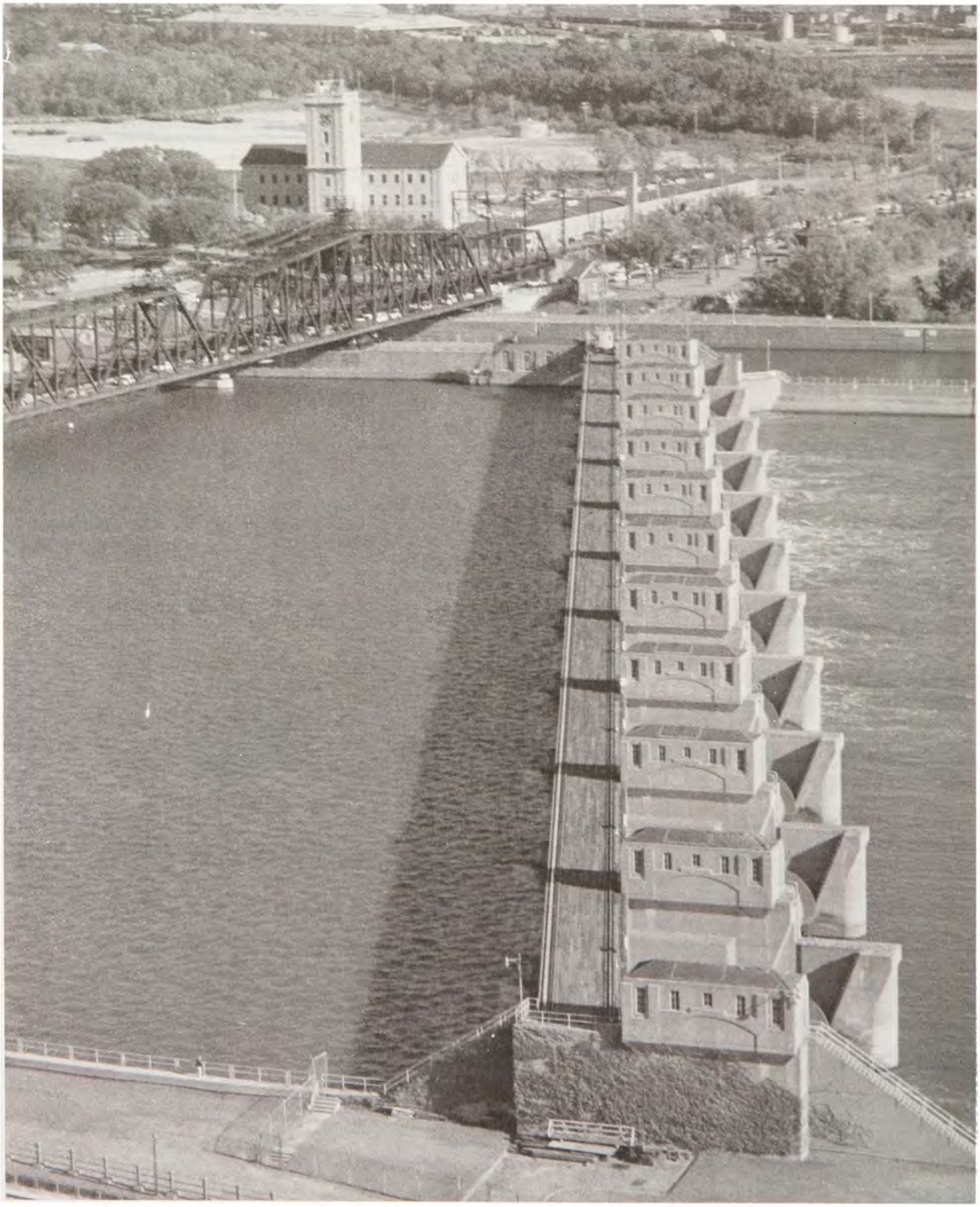
16. "K" at Rock Island District Headquarters to Colonel Walter Fisk, President, Mississippi River Commission, Feb. 4, 1911, Old Rock Island File, RG77, KCFRC.

17. *Annual Report*, 1916, II, p. 2607.

18. Major George Hoffman to President, University of Chicago, March 30, 1917, Rock Island District Files.

19. *Annual Report*, 1924, I, p. 1090.

20. *Annual Report*, 1929, I. p. 1120.



Chapter 9

The Aquatic Staircase

In spite of continued efforts at navigation improvement by the Corps of Engineers after World War I, commercial use of the Mississippi River did not increase as much as had been hoped. Industry, manufacturers and other long-haul shippers seemed to have gotten out of the habit of water transportation.

The problems which shippers faced had little to do with the condition of the channel. Since the late 19th century, shippers and builders had made little attempt to adapt boat designs to either the new channel or to modern commercial needs, and as a result most boats were still too large, too underpowered, and too clumsy to haul freight profitably. Recognizing this, the Corps of Engineers had established an Experimental Towboat Board in 1910 under a $500,000 appropriation to design and construct two experimental towboats and several barges of a more modern design which could utilize the 6-foot channel. This Board met for many years, but never reached an agreement to actually build any boats.

A second problem was the lack of terminal facilities, especially rail-to-river terminals. In the 19th

century boats had just pulled up to the waterfront to unload their barrels and bales without even the need for a dock. When terminals came to be a necessity because of the growing use of barges to haul the cargo in bulk form and because of the competition of railroads who were building their own terminals, no one seemed eager to accept the responsibility. Towns felt it was the responsibility of the steamboat companies, while the packet companies were nearly all too small to afford terminals, were financially strapped already by the railroad competition, and were too individualistic and competitive among themselves to band together to construct terminals. From the beginning the railroads had a much stronger corporate financial base than the packet companies which were run by entrepreneurs more than by boards of directors. Several state legislatures were considering bond issues for terminals as early as 1913, but the war put a stop to these plans.

As a result, it was the Federal government which finally led the way in revitalizing traffic on the Mississippi River. World War I had drained much of the railroad equipment from the Mississippi Valley, leaving industry stagnant for lack of transportation facilities. Consequently, part of the Congressional appropriation of $500,000,000 under the Railroad Control Act of 1917 was assigned to the construction of boats and barges. In July 1918 the Government-organized-and-operated Federal barge fleet inaugurated service on the Lower Mississippi, using equipment commandeered from the Mississippi and Warrior Rivers, and from the New York Barge Canal.[1]

Federal involvement in river transportation expanded in 1924 when Congress authorized formation of the Inland Waterways Corporation to encourage increased use of commercial shipping on the Mississippi from New Orleans to St. Louis. By 1924, not one common-carrier barge line had begun operations on the Mississippi.[2] The Inland Waterways Corporation was to help stimulate such operations by demonstrating that inland water transportation could be economically successful, and by actually beginning regular barge service on routes

that might eventually show a profit and be sold to private business.

Upper Mississippi interests did not take long to request similar Federal aid. In 1925 and 1926 several business groups in Minneapolis met with officials of the Inland Waterways Corporation and with Chief of Engineers General Harry Taylor to see what could be done about extending service to the Upper Mississippi. The IWC had no boat of its own, so it made arrangements for Minneapolis interests to organize the Upper Mississippi Barge Line Company. In a lease executed on January 20, 1926, the Inland Waterways Corporation agreed to operate a fleet of boats and barges built by the new corporation from specifications furnished by the Secretary of War.

In order to examine the state of the channel so as to design boats accordingly, Colonel T. Q. Ashburn, Chairman of the Inland Waterways Corporation, traveled upriver to Minneapolis in April 1926 with barges loaded with ballast. Based on the findings of this trip, the Upper Mississippi Barge Line Company contracted for three towboats and 15 barges. The towboats, built by the Dubuque Boat and Boiler Works, were delivered in the spring of 1927 and put into service.

Meanwhile, the Government-run Federal Barge Lines extended service to the Upper Mississippi in 1926, scheduling two sailings each way from between St. Louis and St. Paul each week.

Under the impetus of this new traffic, river shipping gradually increased and several long-needed river terminals were planned. By 1928 terminals had been built at Burlington and Dubuque, Iowa, and one was under construction at Rock Island. A more general effect of this new traffic was that private and public groups along the Upper Mississippi began pressing Congress for a 9-foot channel between St. Louis and St. Paul similar to that authorized for the Ohio River in 1910 and now nearing completion. After the Upper Mississippi Barge Line Company turned their boats and barges over to In-

land, they devoted their time to lobbying. Strong pressure for a 9-foot channel also came from the Upper Mississippi Waterway Association, the Upper Mississippi and St. Croix River Improvement Association, from Senator Henrik Shipstead of Minnesota, and from many other individuals and groups.[3] Prominent among these were industrial and real estate interests in Minneapolis, who viewed the 9-foot channel as a significant commercial boost for the region.

Rock Island District personnel were more cautious in their views of the new project. In vision, scope, and duration, the series of locks and dams by which the Upper Mississippi would be turned into a commercial canal—an "aquatic staircase"—was larger than all of the former improvement works put together. The 1927 River and Harbor Bill authorized a Board of Engineers to survey the river from St. Louis to Minneapolis with a view to securing a 9-foot channel of suitable width. Rock Island District Engineer Major Charles L. Hall made a preliminary survey in August in 1927. Hall's report did not find the project economically warranted. The report met with a storm of protest from the pro-9-foot channel groups, who applied political pressure to Congress in this election year. Eventually, the report was returned to the Rock Island District Office with the request that a more detailed study be made. Hall had some support from Chief of Engineers General Edgar Jadwin.

Support also came from conservation and recreation groups such as the Izaac Walton League who were worried that the 9-foot channel would destroy the character of much of the 300-mile Upper Mississippi Wildlife and Fish Refuge which had been authorized by Congress in 1924. In a speech to the School of Wildlife Protection in McGregor, Iowa, in August 1929, Hall shared their concerns. The 9-foot channel would create slack water stagnant pools that would alter the wildlife, drive animals away, and provide serious sewage disposal problems to the towns along the new channel.[4] Here again, Hall came in for criticism from those favoring the project, this time for taking ecological concerns into account.

A commonplace criticism of the Corps of Engineers is that it invents projects to give itself work and expand its authority, and then pushes these projects through Congress, but as Raymond Merritt documents clearly in the St. Paul District history, when the 9-foot channel was finally authorized by the Act of July 3, 1930, it came in spite of feelings within the Corps of Engineers. In October 1929 President Herbert Hoover, who had just been elected President, replaced Major General Jadwin with a Chief of Engineers more favorable to the project, Major General Lytle Brown. As late as April of 1930, a list of public works projects authorized by Congress still did not contain the 9-foot channel. It appeared as part of the River and Harbor Act of July 3 that year without a final examination of surveys by the Corps, a victory, as Merritt suggests, "in which glory was shared by President Hoover, his secretary of war, the Mississippi Valley Association, the Minneapolis Real Estate Board, the Mississippi and St. Croix River Improvement Commission and congressional representatives from Minnesota."[5]

The Act of July 3 did not appropriate funds for the entire project, but there was $6,270,000 already appropriated for existing projects but not yet spent, and another $7,500,000 from Public Works and Emergency Relief Funds, and with these work on the project began. The authorization for the project specified that all locks below Minneapolis-St. Paul should not be less than the 110 by 600 feet established for the Ohio River. The Act of July 3 also authorized surveys for a 9-foot channel on the Illinois and Mississippi Canal and for portions of the Rock River.

In beginning this $170,000,000 project the Rock Island District entered a new era which brought many visible changes. Where previous projects had been done at what now seems like a leisurely pace, the whole system of locks and dams was virtually completed in a decade, from 1930 to 1940. Much of the improvement work on the 4½-foot and 6-foot channels lay hidden under the surface in excavations and wing dams, but the 9-foot channel altered

the shape of the river along nearly every mile, replacing the old Mississippi across which Sunday excursionists used to walk during low water with slack water pools, covering the bottom lands and creating countless willow islands where swamps had been. There was also the matter of money. The Rock Island District spent nearly as much money each year on the 9-foot channel as they had spent altogether on the 4½-foot channel.

Another significant difference between this and previous projects was the coordinated planning it involved. The 4½-foot channel project never developed a comprehensive plan. District personnel took so seriously the role of the Corps as "servant of the people" that they habitually waited for Congressional appropriations and directions to plan for the coming year.

The result had been a lack of uniformity in both planning and in results. Major Riche complained in 1910 that in the two districts in his charge (he was still District Engineer of the Second Chicago District), there were 40 locks in five different sizes. These varied from the small 170-foot by 35-foot locks of the Illinois and Mississippi Canal to the Moline Lock at 350 by 80 feet. This lack of uniformity continued when a Board of Engineers fixed the new power company lock at Keokuk at 358 by 90 feet, and when Congress authorized the Le Claire Canal with a 350- by 80-foot lock. In contrast, the new 9-foot channel project produced locks identical in almost every respect.

The 9-Foot Channel Project

The decade of the 1930's was the most exciting period the Rock Island District had ever experienced as it rose to the demands of the 9-foot channel project. The interest generated by the project in towns along the river, the scope of the work, the challenge of something so different from and larger than previous projects, and the Great Depression itself all served to generate a feeling of teamwork that

would be the envy of most other multi-million-dollar corporations.[6] The 9-foot channel boosted local economies and provided jobs for hundreds of professionals and skilled workers as well as for thousands of laborers. Many employees who came to work on the locks and dams in the 1930's remained with the District and kept up the spirit of teamwork long after the project was completed. During the past few years they have nearly all retired.

For both employees and area residents, the symbol of this change from old to new was the move of the Rock Island District Office in 1934 from the overcrowded quarters in the Federal Building where it occupied the second and third floors above the post office, to its own building on Arsenal Island. Storehouse A, popularly known in the area as the Clock Tower Building, was the first building constructed for the Rock Island Arsenal in 1864. Abandoned almost immediately as the remainder of the Arsenal located further eastward on the island, the Clock Tower Building adjacent to the first of the locks and dams planned for the 9-foot channel, made an ideal location for the District. The building quickly came to stand for the District in the minds of area residents.[7]

When the District Office moved into the Clock Tower Building, personnel found themselves with a clear view of the new Locks and Dam 15, begun in 1931 and now virtually complete. Much work already lay behind this new construction.

The first task of the Engineers on the 9-foot channel project was to establish a large real estate and lands section. Because of alterations of the shoreline caused by pooling the water and thus raising the water level, virtually every square foot of both sides of the Mississippi had to be surveyed.

Both natural conditions and population concentrations along the river determined the design, location and number of dams in the project. The low banks of the Upper Mississippi in front of a heavily cultivated flood plain, and the close encroachment of railroad tracks and towns precluded the construction of a few high dams. This meant that the dams

had to be limited to navigation control and would not be able to serve as either power or flood structures. Low dams were also needed if the rural levee systems were to be kept intact. On the other hand, the shallowness of the river itself precluded the use of dams like those on the Ohio River which could be lowered beneath the surface to pass the water during high river stages.

The kind and frequency of floods in the Upper Mississippi Valley also made certain demands on the design of dams. The frequent concurrence of flood discharges from the whole basin indicated the desirability of moveable dams that could be raised entirely out of the water during flood stages. Then, too, the ice which broke up in spring came downstream with considerable force. Any dams on this section of river would have to be both strong, and have wide enough openings to prevent constricting the flow of ice so as to cause ice jams.

There were also considerations apart from navigation and flooding. From the preliminary planning on, the Corps of Engineers cooperated with other agencies to minimize problems the dams might cause. The low dams could not be used for power generation or flood control, but the Corps did work closely with the Bureau of Biological Survey and the Bureau of Fisheries, and made several modifications in design to aid area ecology. For instance, the roller gate design which was selected permitted migration of fish, stabilized water levels, passed silt and sewage, aerated the water to keep oxygen levels up, and in this way benefitted both wildlife and public health. Cooperation of the National Park Service was obtained to insure that areas needed for navigation but not continuously overflowed would be put to maximum recreational use consistent with the project.[8]

The 9-foot channel resulted from a series of 26 locks and dams between Minneapolis and Alton, Illinois, an "aquatic staircase"[9] dropping 335 feet over 662 miles. The lowest lift of any of these locks is 5.5 feet at Lock No. 5A at Winona, and the highest lift is 38.2 feet at the Keokuk Power Dam, now

Lock 19. The Rock Island District built 12 of these locks and dams, from No. 10 at Guttenberg, Iowa, to No. 22 at Saverton, Missouri. Much later, between 1952 and 1957, the District replaced the lock built by the power company at Keokuk with a new Lock 19.

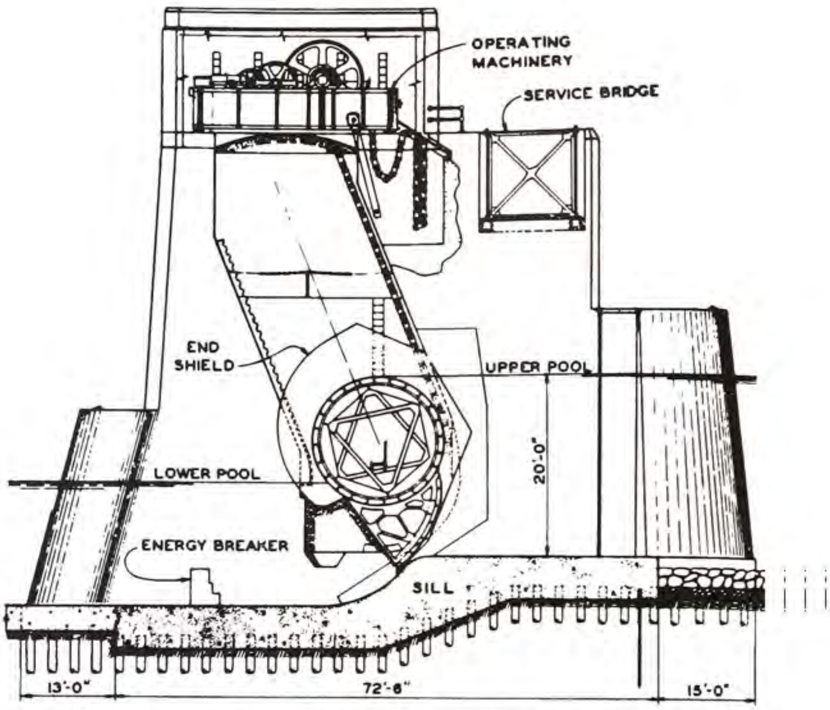
The designing of the locks and dams was begun at the Upper Mississippi Valley Division Office in St. Louis. All of the locks were designed here, as well as all of the electrical work. Contracts for lock machinery were also let by the Division. However, after the designs of the first two dams constructed, Nos. 15 at Rock Island and 20 at Canton, Missouri, were completed by the Division, the responsibility for designing the remaining dams within District boundaries was turned over to the Rock Island Office.

With the exception of Dam 15, all dams were designed with a combination of Tainter and roller gates. The decision to incorporate the newer roller design in the project was due to the need for dams on the Upper Mississippi which could withstand hard usage and which would provide as wide a space as possible between the piers so as to pass ice and drift. Rollers were structurally sounder, and so could be made longer. Dam 15 was built entirely with roller gates because it was constructed at the narrowest part of the channel and was subject to ice jams.[10]

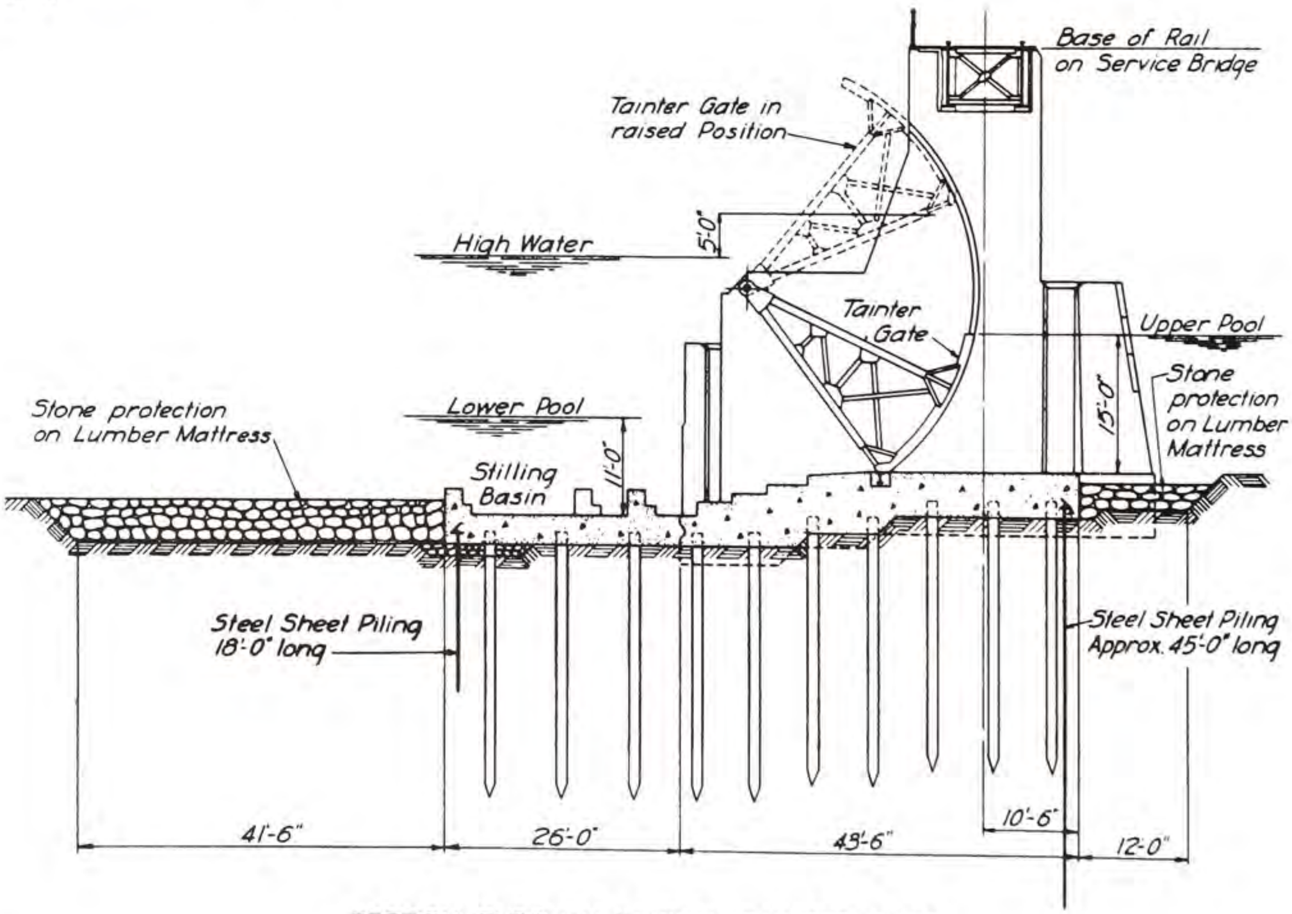
Tainter gates were an old French design. This gate was essentially a pie-shaped wedge of cylinder, with the point downstream and the circumference arc made of metal sheet. The point of the Tainter gate was hinged between piers, and the curved surface upstream formed a dam against the water. The gate could be moved up and down so as to vary the amount of water flowing under the gate from nothing to a completely unobstructed flow when the gate was lifted entirely above the surface of the water. Tainter gates were used wherever possible because they were cheaper to construct, and because they did not require royalty payments as did the rollers.

Cross section of a typical roller gate. Water flows under the roller, the amount controlled by raising or lowering the roller.

A similar view of a Tainter gate used along with rollers on most of the dams on the Mississippi. Tainter gates were not thought to be as sturdy as rollers, but as confidence in them grew, they were used in larger numbers.



TYPICAL SECTION OF A ROLLER GATE



SECTION THROUGH TYPICAL TAINTER GATE

Originally it was the intention to use the roller sections of the dam to pass the normal flow of water, reserving the use of the Tainter gates for flood time or high water. However, District engineers soon discovered that such an uneven flow of water through the dams caused extensive scouring below the dam, endangering the structures and playing havoc with the channel. Since then, all gates in a dam have been kept at about the same level. (This created problems at a dam like No. 20 at Canton, where the 40 Tainter gates were moved by a traveling crane—a slow process if one is attempting to keep them even. Ironically, water flow is more critical at No. 20, since it is the first dam below the mouth of the Des Moines River.)

The roller gate had been developed in Germany and was still under patent when the dams were built. Over 100 roller dams had been built in Europe, but they were quite new as far as navigation projects in the United States were concerned. The first roller dam had been built in Washington in 1912. There were nine other such dams in the United States before 1930.

The roller gate was essentially a hollow cylinder which could be raised or lowered to control the level of the water passing underneath. On the upstream side of the roller a steel apron extended along its length. When the gate was closed, the lower edge of this apron rested against a steel sill even with the riverbed. In addition to their strength, roller gates had the additional advantage of offering less friction to water passing underneath than other types of dams.

With the exception of Dam 15, all of the other dams on the 9-foot project contained roller and Tainter gates, and most of the others contained a fixed, or dike, section made of earth or, less often, concrete. These fixed sections contained a combination of spillways, overflow sections and non-overflow sections depending on the requirement of a particular area.

As the construction progressed in the 1930's, advances in both design and materials permitted the

construction of wider Tainter gates, decreasing the need for rollers. In 1930 the limits of a Tainter gate were thought to be 40 feet, but this gradually increased. Dam No. 17 at New Boston, Illinois, completed in 1939, had eight 60-foot Tainters and three rollers; and Dam 13 at Clinton, Iowa, also completed in 1939, had ten 64-foot Tainters and three roller gates.

Most of the dams were designed solely for navigation. However, power is still generated at Dam No. 1 (completed in 1915 before the 9-foot channel project) under a license from the Federal Power Commission by which the Corps is reimbursed for power expenses. Water power is also used to generate small amounts of hydroelectricity at Dams 2 and 15 to operate lock machinery.

Although the general location of the dams was determined to a great extent by the rate of fall in various sections of the river, the exact location was determined by considering the locations of the towns along the shore. Wherever possible, dams were located just above towns so as to minimize any changes to the waterfront. The shorelines were changed least just below the dam in the system, and most just above the dams where the pools of water retained by the dams were deepest.

All of the locks in the Rock Island District are a uniform 110 by 600 feet, with the exception of Lock 19 at Keokuk, built in 1913. Lock 19 was 110 by 358 feet until it was replaced by a new lock in 1957. Each of the dams also contained an uncompleted auxiliary lock 110 feet wide and 269 feet long. Only the auxiliary lock at Dam 15 was completed. All of the locks use miter gates electrically operated, and a gravity fill system in which water enters or leaves the lock chamber by tunnels underneath the bottom of the lock.

Locks and Dam 15. The first lock and dam to be constructed was No. 15 at Rock Island, located on the downstream tip of Arsenal Island just above and below the Government Bridge which connects Arsenal Island to Davenport. The dam is situated

on a diagonal, pointing downstream from the south abutment at a 16½-degree angle to the normal channel line. The maximum head or difference in pool elevation is 16 feet.

In all cases the locks were built first so as not to interrupt river traffic. The contract for two parallel locks at Dam 15 was let on April 23, 1931. By June 30 the contractor had nearly completed the cofferdam around the south approach to the drawspan of the Rock Island Bridge (which the new locks would utilize). The main lock was completed on March 20, 1932, less than a year later, and in April construction of the auxiliary lock began. The purpose of the auxiliary locks at each dam was to take care of a projected future increase in traffic.

Both locks at Dam 15 are 110 feet wide. The main lock is a standard 600 feet long, while the auxiliary lock is 360 feet. Guide walls approximately 40 feet high extend 600 feet upstream from the upper gate and 1,100 feet downstream from the lower gate. The top widths of these walls vary from 6 to 40 feet, the wider portions serving to provide room for equipment, machinery, and storage and shelter houses.

Water enters or leaves the lock chamber through four tunnels, two for each lock. Those in the main lock are 12½ feet square; those in the auxiliary lock are 10 feet square. The tunnels take water from the pool above the lock chamber and discharge into the river below the chamber. Two Tainter valves in each tunnel, one just downstream from the intake and one just upstream from the discharge ports, control the flow of water in and out.

When bringing the chamber level up to that of the upper pool, the lower valves are closed and the upper opened. The water flows into the lock chamber from the tunnels through 4- by 3-foot openings spaced 25½ feet apart in the main lock and 20 feet apart in the auxiliary. When the water in the lock chamber equals the level in the upper pool, the upper gates are opened to let boats in or out. Water flows out these same openings into the tunnels when lowering the chamber level to that of the lower pool.

Initial construction on the 9-foot channel began with this coffer dam at Lock 15, adjacent to the new headquarters of the Rock Island District.

Both upper and lower lock gates are miter gates opening upstream. Each leaf of each gate is operated by a 25-horsepower electric motor.

The contract for the roller dam and appurtenant sea wall and intercepting sewer was let on February 8, 1932, and work got under way in the spring. By the end of the first fiscal year of work on the 9-foot channel, the Rock Island District had completed $3,132,814 of work.

Dam 15 was built on a limestone ledge lying 3 to 7 feet below a layer of silt, clay, sand, and broken rock forming the riverbed. As excavation for the dam progressed, a number of cavities (including four very large ones) were uncovered. These were cleaned of debris and filled with concrete.

The moveable section of Dam 15 is made up of 11 roller gates each 99.3 feet long, mounted between concrete piers. On each cylinder a steel apron 13 feet wide extends full length along the upstream side. Both ends of each gate have cast steel teeth partially encircling the cylinder; these teeth fit into cast steel racks set into the sides of the piers on an incline. The gates are raised or lowered by a link chain

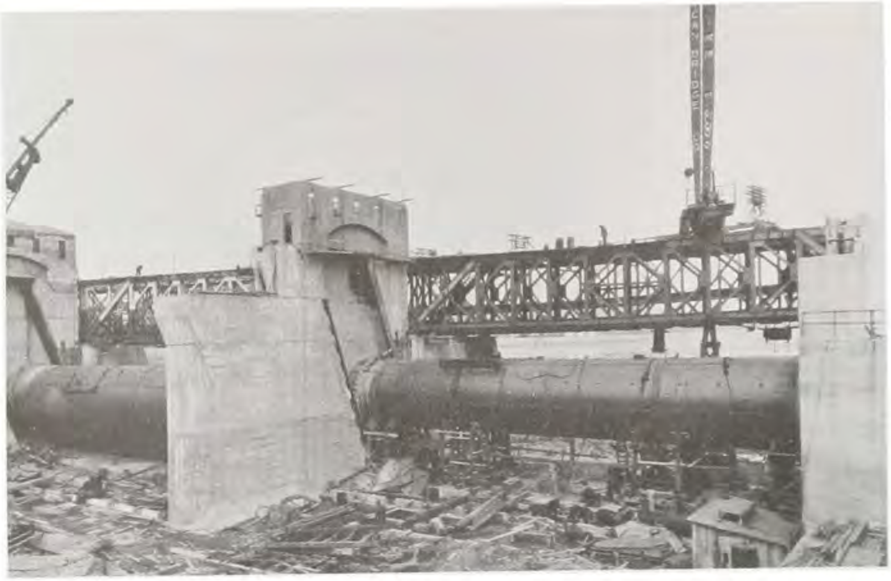
Construction on Dam 15 at Rock Island shows its location just downstream from the Rock Island Bridge. Lock 15 utilizes the original drawspan of that bridge.

at the end of each roller, powered by individual 50-horsepower electric motors.

Nine of the rollers in Dam 15 are 19 feet, 4 inches in diameter. The ones nearest the Iowa and Illinois shores are 16 feet, 2 inches. These end gates, called skimmer gates, permit an overflow to keep the surface of the upper pool free of debris. The other rollers never overflow. The height of the rollers closed, including the apron, is 26 feet for the main gates and 21 feet, 9 inches for the smaller end gates.

The roller gates are operated to keep a pool elevation of about 561.0 feet above sea level, or a minimum channel depth of 9 feet at the upstream end of the upper pool. The rollers are raised gradually as water flow increases, beginning with the center and working outward. The two end gates are always left slightly raised. On the Iowa side this insures that there is always moving water at the sewer outlet, while moving water on the Illinois side provides good water for Rock Island's water supply intake.

On the Iowa side, the major problem caused by the locks and dams was that raising the water in the pools interfered with many urban storm and sani-



Roller gates in place at Dam 15.

Construction at Lock 15.

tary sewers, including those in the cities of Davenport and Bettendorf, where some 60 outlets were affected. To take care of this problem, a seawall and intercepting sewer were constructed from a point 136 feet below the first roller gate upstream nearly two miles to where the natural bank gave protection. At this point the seawall ended and a concrete box sewer of gradually diminishing size, covered by a rip rapped earth levee, extended upstream to near Duck Creek in Bettendorf, about 4½ miles from the outlet. Five sluice gates were provided in order to allow the river to flush the sewer.

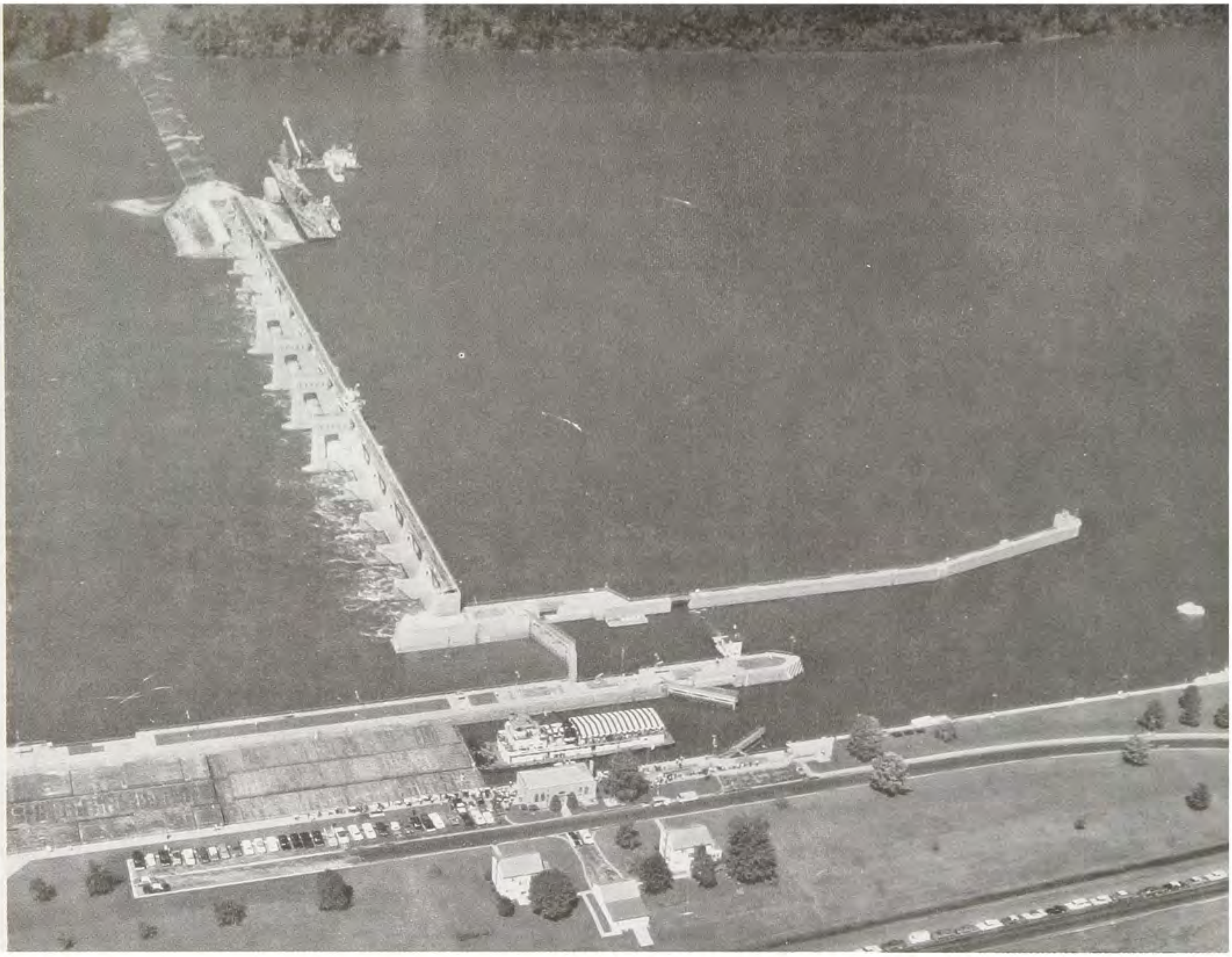
A steel truss service bridge extends over the entire length of the dam on the upstream side. On this bridge a 15-foot-gauge track supports a 30-ton electric crane with a 50-foot boom, used to service the heavy gate machinery and remove large pieces of debris. On the lower chord of the service bridge is a bridge crane used to place emergency bulkheads in front of the roller gates. These bulkheads are trussed skinplates which fit in slots on the upstream side of the piers, forming a cofferdam so that the roller gates can be removed for overhaul or repair.

The control house for the dam is on the wall at the south end of the dam. Here a 312-kilowatt generator puts out electricity to run the lock gates and the roller gates. The excess power, if any, runs to the Clock Tower Building for use there. The waterwheel that runs the generator lies 12 feet below the surface of the river. A backup diesel unit is added to the system when the generator falls short, as it does during high water periods.

Locks and Dam 15 was opened to traffic in the spring of 1934. The machinery was installed in the locks by March 31, and the roller dam was completed on May 9. The total cost of the installation to its completion in 1934 was $7,480,000.

Other Locks and Dams. The construction of the remaining locks and dams followed much the same steps as Locks and Dam 15. Following the design of Dams 15 and 20, the Upper Mississippi Valley Division turned over the design of the remaining dams to the Rock Island District, where a force of 200 engineers, many of whom had been out of work because of the Depression, worked on the project. The overall design of the remaining dams was supervised by James Reeves and Edwin Franzen, while Frank Ashton had responsibility for the dam gates.

Major Raymond A. Wheeler arrived as District Engineer in the fall of 1933 to supervise the construction of five more locks and dams. Lock and Dam 20 was begun in November, as was No. 18



An overview of Lock and Dam 21 at Quincy, Illinois, showing components similar to those at most of the dams: locks, Tainter and roller gate sections, spillway, and levee.

north of Burlington, Iowa. In December work began on Nos. 16, 11 (at Dubuque), and 12 (at Bellevue). In deciding on the order in which to build the locks, Engineers followed the old practice of starting with the worst spots and ending with those having the least problem. Locks and Dam 15 had been the first because of continued problems with the Rock Island Rapids.[11]

Funds for the 9-foot project came from several sources in addition to the regular River and Harbor appropriations. On June 16, 1933, $33,500,000 was allotted from the National Industrial Recovery Act, and in 1934 additional funds amounting to $50,500,000 were allotted by the Federal Emergency Administration of Public Works. With this money work proceeded at a rapid rate. The total cost of work in the Rock Island District during fis-

cal 1934 was $6,390,467.47, more than double the amount spent during the first year of the project.[12]

In 1935 the River and Harbor Bill of August 20 authorized an appropriation of the entire amount required for completion of the project. Most of the funds had previously come from the Public Works and Emergency Relief funds. For example, in fiscal 1935 regular River and Harbor appropriations paid for $51,906.98 of new work, Emergency Relief funds had paid for $19,302.23, and the rest, $11,488,434.03, came from the Public Works Administration.[13]

Lock 10 at Guttenberg was placed in operation on May 25, 1936, even though the dam was not yet done. Later that year operation and maintenance of this lock and dam was transferred to the St. Paul District. By 1939 the last of the locks and dams were nearing completion. Nos. 12, 21, and 22 were finished in 1938. In April 1939 Nos. 13 and 17 were completed and in June the last lock, No. 14 at Le Claire, was opened to navigation. Lock and Dam 14 had been left until last because the Le Claire Canal built in 1922 already provided a fairly good channel over the upper section of the rapids. Lock 14 was built adjacent to the Le Claire Lock at the foot of the Le Claire Canal. Completion of Lock and Dam 14 at a cost of $5,472,000 marked the beginning of a new era in Upper Mississippi transportation, and the end of the last section of the long-troublesome Rock Island Rapids.

Since 1969 the old Le Claire Canal and Lock has been used as an auxiliary lock for the passage of recreational craft. Beginning in 1969, it has been available for use only on summer weekends. A major renovation project was begun at the Le Claire Lock in 1979 and completed in 1981. New lock gates and machinery were installed, lock walls were repaired, and a new lock house was constructed. The old canal grounds now house the Corps of Engineers Le Claire Base, consisting of the motor shop, a warehouse to store equipment, and offices for personnel from the overcrowded Clock Tower Building.

By June 30, 1940, a controlling depth of 9 feet had been reached in all pools in the Rock Island District

at a total cost to that date of $69,609,229.44. The original estimate for the entire project in 1931 had been $140,000,000, but this was gradually revised upward by 1940 to $170,000,000, partly due to changes and additions made to the project as it went on.

The one lock that still did not come up to standard dimensions in 1940 was Lock 19 at Keokuk, which had been built by the power company. The same act which authorized the 9-foot channel in 1930 also authorized a second lock at Keokuk to meet the standard 110- by 600-foot dimensions. The lock built by the power company, which also lacked the 9-foot depth required, would become the auxiliary lock.

Planning for this new lock was begun by the Rock Island District in 1930, but there were problems with its location. Building the new lock east of the existing one would interfere with the power plant, while a new lock on the landward side of the dry dock would isolate the dry dock from land, making the delivery of supplies difficult.[14]

To overcome these problems District engineers first planned to build the new lock immediately downstream of the dry dock and connected to it. The dry dock would then be used only in emergencies or during the closed navigation season. The first estimate of the cost of the new lock was $1,500,000.

Between 1935 and 1937 the Rock Island District made many studies of locations for the new lock. These included building landward or riverward of the existing lock, enlarging the existing lock, extending the dry dock to create a 600-foot lock, and using the site of the dry dock itself. These studies concluded with a plan to build the lock at the dry dock site and build a new dry dock landward of the lock. The design of this lock was to be consistent with the other locks on the 9-foot channel project, most of which were now nearing completion.

Numerous tests for filling and emptying systems were carried out between 1938 and 1941. In 1941 the Office of the Chief of Engineers authorized the

Rock Island District to proceed with detailed plans and specifications for a new lock at the dry dock location and to undertake model studies.

At this stage of the design, District engineers planned to use a Tainter gate in lieu of miter gates at the upper end of the lock. Tainter gates used in several of the dams on the 9-foot channel had given superior performance under the ice conditions on the Upper Mississippi. This Tainter lock gate would submerge to admit boats during locking, rather than opening against the lock walls as the miter gates did.

A dramatic change in planning for new Lock 19 occurred in 1945. Completion of the 9-foot channel had created a bottleneck at Lock 19. Lines of tows often waited many hours to pass through the smaller lock at Keokuk. Responding to studies within the District which showed a clear trend toward heavier and longer tows on the Upper Mississippi, Rock Island District planners recommended to the Office of the Chief of Engineers that the length of the new Lock 19 be expanded to 1,200 feet. The 38.2-foot drop at Keokuk was by far the largest of any lock in the District, and the capacity to lock through in one long tow would be especially timesaving.

With the change in dimensions came a change of location. The Rock Island District proposed to build this new lock on the landward side of the dry dock, almost directly over the site of the Des Moines Rapids Canal.

A hearing was held at Keokuk on August 16, 1945, to explain the project to the public and to receive opinions about the lock from navigation interests and others. Several hundred notices were sent out to congressmen, senators, local politicians, corporations and private citizens, but fewer than 15 people showed up at the meeting chaired by District Engineer Lieutenant Colonel John Peil. Japan had surrendered two days earlier, and the whole country was celebrating.

Construction at new Lock 19, taken June 1955.

General opinion toward the project, however, was very favorable, and modest funds for planning were authorized between 1946 and 1949. By 1950 work on the design and plans for the new lock was being carried out by the Rock Island District, by the Upper Mississippi Valley Division at St. Louis, and by the Office of the Chief of Engineers in Washington, D.C.

In 1950 District planners decided against moving the dry dock to another location in the District. Instead, the dry dock would remain at Keokuk for use on an emergency basis, while a service base for storage and repair would be established near the old Le Claire Canal Lock.

Final model tests of the new 1,200-foot lock were performed by the St. Paul District at Government laboratories in Iowa City, Iowa. At this point, plans still called for a Tainter-type upper service gate. A submersible, vertical lift gate was substituted in 1952 just prior to the start of construction.

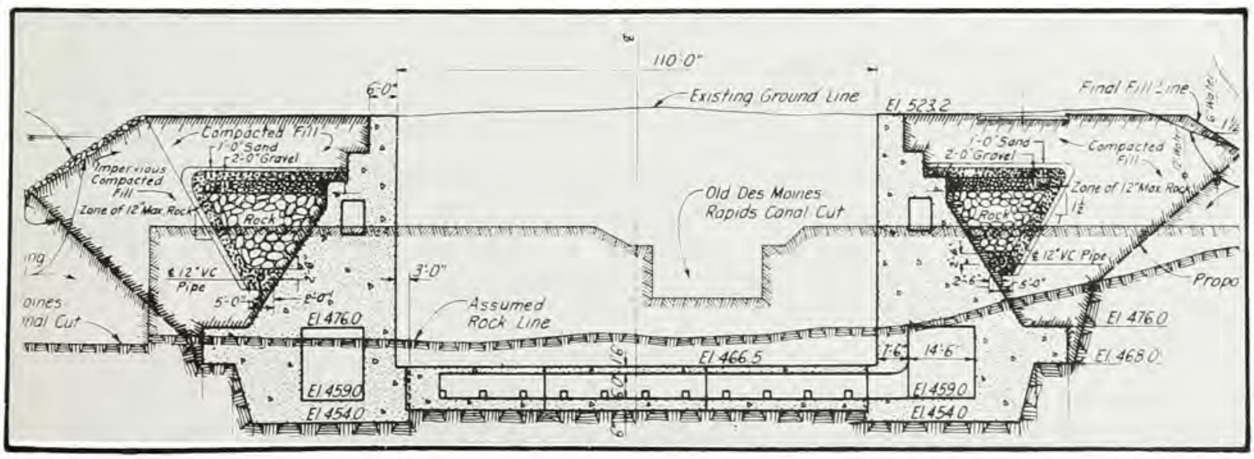
With plans and specifications nearly done, Congress in 1952 appropriated $994,000 to begin construction. While the Korean War brought nearly all other activities in the Rock Island District to a standstill, appropriations for new Lock 19 continued on schedule, an indication of the economical and military importance of the project.

All of the work on the new lock between 1952 and 1957 was contracted out in four stages involving four separate contracts. Stage I consisted of the lower guide wall extending from the lock proper. These guide walls were longer than usual so as to insure a proper lineup for tows. The river guide wall extended far enough to enclose the swing pier of the Keokuk and Hamilton Bridge downstream from the lock, making passage through the bridge easier and safer. Stage I was begun late in 1952 and completed in April of 1954.

A month later construction began on Stage II, consisting of the lock proper, and lock gates, Tainter valves for filling and emptying, operating machinery, and the esplanade around the lock. Stage II was complete enough to operate by the spring of 1957.

Stages III and IV were smaller contracts, involving mechanical and electrical equipment for operating the lock, and the installation of this equipment. These stages, too, were completed in 1957.

A cross section of the new lock, showing its location atop the old Des Moines Rapids Canal, and its much larger size.



With new Lock 19 nearing completion in the spring of 1957, Rock Island District officials planned a ribbon-cutting ceremony to celebrate the opening scheduled for the second week of May. However, on May 1, while the Stage II contractor was testing the operation of the new lock prior to turning it over to the Corps of Engineers, a tow coming upstream waiting to go through old Lock 19 encountered cross currents caused by the testing and requested permission to come through the new lock. The contractor received permission from the Rock Island District to do so, and so the *Hawkeye* with 12 barges of coal became the first boat through the lock. The first locking-through took one hour; at the old lock the same tow would have required five hours.

Two weeks later, on Tuesday, May 14, the Rock Island District formally opened new Lock 19. When the lock opened at 8 a.m., the *Lachlan Macleay* of the Federal Barge Lines entered the lock, greeted by only a handful of District employees. The tow of seven barges of steel, sulphur, and coal locked through in one-half hour.

Formal dedication ceremonies for Lock 19 were held on August 19, 1957. In addition to Rock Island District personnel, speakers at the dedication included Assistant Secretary of the Army Dewey Short, Chief of Engineers Major General Emerson C. Itschner, and Iowa Governor Herschel Loveless. The official dedication at 3:00 p.m. followed a luncheon, open house, and parade.

Lock 19 was completed at a cost of $13,500,000, somewhat more than the 1930 estimate of $1,500,000. It still remains the largest and most impressive lock on the Upper Mississippi. It furnishes a usable lock chamber 110 feet wide by 1,200 feet long. Depth over the upper sill is 15 feet, with 13 feet over the lower sill. The maximum lift at low water stage is 38.2 feet.

All three lock gates are of steel construction. The downstream gate is a miter type, while both the upper service gate and the guard gate are submersible

vertical lift gates. In addition to protecting the service gate against damage from tows and ice flows, the guard gate serves as a roadway for vehicle access to the old lock and power dam.

As with all other locks in the Rock Island District, Lock 19 is filled and emptied by gravity. Intake and discharge valves control the water, which enters through intakes in the upper sill and is distributed to the lock through lockwall culverts. These in turn distribute the water to lateral culverts under the lock floor. The same system is used to discharge the water at the downstream end of the lock. The filling and emptying system fills the lock chamber in approximately ten minutes and empties it in about nine minutes. Just over 3,800,000 gallons of water are used for each emptying or filling.

Effects of the 9-Foot Channel. The 9-foot channel began to make a difference on the Upper Mississippi even before it was finished. The Upper Mississippi Wildlife and Fish Refuge Act passed in 1924 authorized the Biological Survey to buy overflow lands along the Upper Mississippi River. Conservationists at first felt that the 9-foot channel would ruin the potential of the valley for a wildlife refuge.

However, as the first pools were filled, the cooperative planning between the Engineers and the conservationists began to show results. In 1937 Ira Gabrielson, Director of the Fish and Wildlife Service, wrote an article in *Scientific American* in which he concluded that the dams were having a positive effect:

> A fine example of how large dams may help the wildlife resources is developing now on the Upper Mississippi River Wildlife Refuge near Winona, Minnesota. Two of the pools created here by the flood control and navigation dams have relatively stabilized water levels. These dams, which might easily have been so designed as to destroy most of the wildlife value of this great area are actually increasing these values. In the shallow portions of these stabilized pools, which lie outside the navigation channel, water plants, both the submerged acquatic and the emergent vegetation favorable to waterfowl and other marsh-loving birds, are establishing themselves in abundance.[15]

In a later book, Gabrielson pointed out that no single conservation organization could have benefitted wildlife so much as the Army Engineers had in

Modern river traffic is far more sophisticated than the old steam traffic. Here the towboat *Winchester* passes through Pool 16 with a $2,455,200 tow of linseed oil.

their 9-foot channel project.[16] In 1939 the Corps of Engineers turned over 150,000 acres of overflow lands between Davenport and Lake Pepin to the Biological Survey for use as a wildlife refuge.

But of course it was primarily for navigation that the 9-foot channel was developed, and here, too, the effects of the improvement began to show, although World War II held the growth of river traffic to a slower pace. Until 1946, because of the war, traffic remained relatively modest, averaging about 2,000,000 tons of freight per year. Then in 1947 the towboat *Alexander Mackenzie* took a cargo of 18,500 tons up to St. Paul in one trip. By comparison, in 1857 the 22 boats that arrived at St. Paul brought 2,500 tons of freight. The *Alexander Mackenzie*'s single load amounted to ½ the tonnage towed *annually* by the four packets of the Diamond Jo line between 1900 and 1910.

By 1950 freight passing through the Rock Island District had surpassed 5,000,000 tons; in 1959 the amount reached 10,000,000 tons for the first time. By 1972, freight through the Rock Island District exceeded 25,000,000 tons,[17] while traffic originating in the District or terminating there slightly exceeded 6,000,000 tons. Nearly every year continues

to find new records set, although the uncertainty of the length of the winter ice period and other problems such as low water, the grain harvest, and the nation's economy all cause river traffic to fluctuate from year to year. Overall, however, river traffic has shown steady growth. In 1980, the tonnage shipped through the Rock Island District exceeded 34,000,000 tons, and August of that year set the highest single monthly cargo total in the history of the 9-foot channel: 4,543,525 tons.

The 9-foot channel has brought about changes not only in the amount of river transportation, but in the methods as well. Gone is the steam engine with its paddle wheel which had been a necessity in the shallow natural channel. In its place have appeared larger and larger diesel towboats. A typical modern towboat operating on the Upper Mississippi is around 165 feet long and perhaps 35 feet wide, with a draft of slightly over 8 feet and powered by as much as 5,000 horsepower.

The standard barge which accompanies these towboats is 195 feet long, 35 feet wide, with an 8- to 9-foot draft. One of these barges can carry 1,500 tons of coal or grain, or up to 10,000 barrels (420,000 gallons) of petroleum products, or 45,000 bushels of grain. Each barge can carry the equivalent of 25 to 35 railroad cars. These barges are made up into tows that often contain 12 to 14 barges, and may contain as many as 15 to 17. Seventeen barges is the practical limit on the Upper Mississippi since it is the most that a double lockage can handle. The record of 17 barges was first set by the towboat *W. S. Rhea* on August 11, 1957; since then tows of 17 barges have become frequent. When locking this many barges through, the first nine barges are sent through the lock, three abreast; the second lockage sends through the remaining eight barges and the towboat (placed in the last row with two barges).

A modern towboat with 14 barges can carry the equivalent of 140 packet steamboats of the kind active on the Upper Mississippi when Colonel Wilson arrived in 1866 to organize the Rock Island District.

Along with an increase in traffic has come an increase in the number of terminals. In 1940 there were four terminals in the Rock Island District; by 1961 there were 70. River traffic today gives no indication of levelling off. The 9-foot channel has done its job well.

Notes

Chapter 9

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7. For a brief history of the Clock Tower Building, see Appendix 3.

8. *Report of the Federal Civil Works Program as Administered by the Corps of Engineers, U.S. Army, 1951*, Part 1, Vol. III (Washington, D.C.: Government Printing Office, 1952).

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11. Interview with Robert Clevenstine, June 21, 1973.

12. *Annual Report*, 1934, I, pp. 783-793.

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Chapter 10

Military Construction

Completion of most of the work on the 9-foot channel and the coming of World War II slowed down civil works in the Rock Island District. Total expenditures for new work and maintenance in fiscal 1942 was $2,494,719.98. As with the rest of the country, the District shifted to the war effort—specifically, to military construction.

Prior to World War II, building construction for the Army had been done by the Quartermaster Corps. It soon became apparent, however, that the Quartermaster did not have an ongoing, adequate organization to handle a sudden large increase in construction. Here is where the Corps of Engineers' involvement in civil public works made good military sense. Because of their work on America's waterways, the Engineers had both the staff and experience to engage in large scale construction projects. Especially important was their long experience in working with contractors. Contractors knew the Corps of Engineers, and the Engineers knew which contractors could do which jobs. Consequently, in 1940 all Air Corps construction and all work on the Atlantic island bases were assigned to the Engineers; on December 1, 1941, Congress assigned all military construction to the Engineers.[1]

Because of their more strategic locations, the St. Louis and Chicago Districts carried out most of the military construction work in the Upper Mississippi region. The St. Louis District supervised construction of about $500,000,000 worth of facilities,[2] while the Chicago District, located in the Great Lakes region, an important manufacturing center, supervised some of the largest Corps military projects.[3] In addition, Chicago became the headquarters for a procurement district that included 12 states and went far beyond the boundaries of the Chicago District.

Nevertheless, the Rock Island District did undertake a significant amount of military construction and, as with the other Engineer efforts, it amazed those for whom the construction was being done by the rapidity with which it adapted to military construction. During each of the war years, the Rock Island District procured over $270,000,000 worth of supplies and equipment. During 1942 personnel at Rock Island designed and constructed more than $80,000,000 of military projects.

Most of this work was carried on by civilian personnel and by private contractors, but several District employees were commissioned into the Engineer Corps and a number of reserve officers were transferred to Rock Island to supervise various aspects of construction. One of these civilian employees was John Peil, chief of the planning section. In July 1942 Peil was commissioned as Major in the Engineers and in February 1943 he was promoted to Lieutenant Colonel and reassigned as District Engineer at Rock Island for the duration of the war.

The Rock Island District's first military construction project was for the Rock Island Arsenal. Even before the war began, District personnel were working on preliminary plans to expand several facilities at the Arsenal to meet the increased needs of the Lend Lease program. The District had already designed and constructed a badly-needed new forge shop before the war began.

The first of the wartime projects at the Arsenal was an administration building constructed in 1942. A cafeteria constructed in a rehabilitated shop building followed, along with several underground machine gun testing ranges and two new buildings, Nos. 208 and 209.

Across the Mississippi from the Arsenal, in Bettendorf, Iowa, the Engineers took charge of a tank arsenal project begun by the International Harvester Company for the Ordnance Department. The Quad Cities Tank Arsenal was set up in the old Bettendorf Car Shop where a foundry already existed and whose heavy equipment could be easily transferred from making railroad cars to tanks. In setting up this project, Engineers had to move the Bettendorf Company, which was making equipment for the Navy, to an Engineer-constructed building in Moline, Illinois.

The 94 M3 Grant tanks produced at Bettendorf were designed by the Rock Island Arsenal as part of a series which eventually led to the design of the Sherman tank. The Quad Cities Tank Arsenal was plagued from the beginning with problems ranging from constant design changes to suppliers who were months behind. In addition, the tanks were made of riveted plate stock and the British troops who used them found them extremely vulnerable.[4] Finally no sooner was the facility finished than the Government found itself with an excess of tank-producing plants, and production soon shifted to tracked personnel carriers.

Only one World War II facility was designed and constructed entirely under the supervision of Rock Island District personnel: the Green River Ordnance plant at Amboy, Illinois, built in 1942-43. As with all major military projects, the Green River plant was designed and built by contract from Government specifications. Nevertheless, construction of the plant required a large supervisory force for which an area office was set up at Dixon, Illinois.

Other major military construction projects supervised by the Rock Island District included Schick

General Hospital at Clinton, Iowa. Built from standard military specifications, Schick was the only hospital built by the District under wartime conditions. Following the war, however, the District supervised construction of two hospitals for the Veteran's Administration at Iowa City, Iowa, and Madison, Wisconsin.

The Rock Island District performed some additional military construction at the Ordnance Proving Grounds at Savanna, Illinois, where it built several Igloos, semi-buried munitions storage buildings. District personnel also built the first Women's Army Corps training camp in the United States at Fort Des Moines, Iowa, refurbishing several old buildings and constructing several new ones.

To reach all of these scattered military projects, the Rock Island District assembled a vehicle fleet of about 300 pieces, including 57 brand-new 1942-model Pontiac and Chevrolet station wagons and sedans.

Following the end of the war in 1945, the District returned to civil works. Since then, military construction within the District has been carried out by the Chicago District, and more recently, by the Omaha District. The Rock Island District has remained entirely with civil works programs.

Notes

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3. John Larson, *Those Army Engineers, A History of the Chicago District U.S. Army Corps of Engineers* (Washington, D.C., GPO, 1980), pp. 261-268.

4. Interview with Robert Clevenstine, June 21, 1973. This and other information in this chapter comes from brief District records, but primarily from Robert Clevenstine and Frank W. Ashton who were in charge of various aspects of military construction for the Rock Island District during World War II.

Chapter 11

High Water, Low Water

The river belongs to the nation,
The levee, they say, to the state;
The government runs navigation,
The commonwealth, though pays the freight.
Now, here is the problem that's heavy —
Please which is the right or the wrong?
When the water runs over the levee,
To whom does the river belong?
— Anonymous[1]

Floods, or freshets as the 19th century population of the Mississippi Valley liked to call them, have been a perennial problem. On the lower river such floods, carrying water from tributaries that form a drainage basin stretching from Glacier National Park in Montana to northern New York, once overflowed natural levees left by silt from the flooding river into thousands of acres of lowlands. To prevent flooding there, natural levees were raised. Along the Mississippi north of St. Louis, however, the problem is different. Here both farm land and towns lie squeezed in narrow strips of bottom land which end abruptly with high bluffs. There is no wide flood plain to spread the water out. Towns and farms "on the hill" are safe in even the worst flood, but the parts of towns which border the Upper

Mississippi are often in some danger even after a good rain, and they are particularly vulnerable to a major flood.

For some reason, floods along the Mississippi River seem to have come in cycles or "wet decades." Periods of high water seem to alternate with years of unusually low water. Wet decades occurred in the 1820's, the 1840's, the 1880's and the 1940's. The most recent wet cycle began in the mid-1960's and continued into the early 1970's. In this last wet cycle, two of the worst floods on record have occurred.

Floods along the Upper Mississippi, while different from the spread-out shallow floods of the lower river, are also quite different from the spectacular gully washers of the Western states or the floods along deep narrow valleys or canyons such as that at Rapid City, South Dakota, in 1972. Those dramatic floods can splinter trees and wrap cars into knots.

A Mississippi flood is comparatively quieter and more ponderous. Weeks ahead of time the Weather Bureau, with the assistance of the Corps of Engineers, is able to predict with fair accuracy the probability of a flood by observing the amount of ground water left from the previous summer and fall, the snow cover, and other such measurements of available water. Days ahead of time, as the weather pattern becomes clearer, they can predict the seriousness of the flood and also, within hours, exactly when the crest will pass any given town along the river. More often than not they are within inches of the correct flood stage. Newspapers, radio, and television follow the crest down the river, and as it arrives at each of the towns it becomes a social event. Townspeople turn out along the waterfront to watch the water slowly inch up the street.

This deliberateness makes a Mississippi flood seem different from other natural disasters. Tornados and blizzards show their violence, but a flood hides its destruction under a disarmingly calm surface. The current eating away a foundation is not so

visible, and it becomes hard for observers to imagine that millions of dollars of damage are being done while children ride bicycles down streets covered by inches of water.

But the leisurely pace of the flood is deceptive. Bit by bit foundations crumble, water supplies are contaminated, belongings ruined, farmlands made useless for the coming season. As the flood wears on time is lost at factories, roads wash out and buckle. For those directly involved, and indirectly for every taxpayer, a flood is expensive — more expensive each year as populations and industry increase along the river, and, against strong advice, encroach onto the flood plains.

Early Flood Control Work. Combating floods was at first left in the hands of individual residents. South of the Ohio River early in the 19th century, owners of land along the river's edge were responsible for constructing and maintaining levees along their own portion of land, putting all the burden on them and none on landowners further inland, who benefitted as much as property owners along the river. When this practice eventually proved unworkable, the concept of levee districts developed. These districts included all threatened residents within an area which could be protected by a single levee. Residents in towns further north built their houses on stilts, sought high ground, or, if they were true river rats, lived with nature, expecting to have to move furniture up to the second floor every few years.

In spite of the need for more systematic national flood control planning, the Corps of Engineers did not become involved in flood control in a major way until the Flood Control Act of 1936 put the responsibility for such control with the Engineers.[2]

Prior to this such flood control as the Rock Island District engaged in was piecemeal and often disguised as "navigation improvement." The Corps had on occasion aided flood victims, as in the spring of 1882 during the disastrous floods south of St. Louis when the *Barnard* and the *Coal Bluff,* along

with District personnel, went south with supplies. Even this emergency relief, however, needed to be authorized by a Congressional resolution. Primarily, the Corps remained limited to its single-purpose navigation projects.

The first official departure from single-purpose navigation projects came in 1879 when Congress established the Mississippi River Commission. The Commission consisted of seven members: three appointed from the Corps of Engineers (one of whom was to serve as president), three from civilian life, and one from the United States Coast and Geodetic Survey. In the Act of June 28, 1879, establishing the Commission, Congress directed that they survey the river and develop plans which would "correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River; improve and give safety and ease to the navigation thereof; prevent destructive floods; promote and facilitate commerce, trade and the postal service."[3] Further, Congress gave the Commission power to initiate plans. In spite of these broad directives, however, "aid to navigation" remained the official justification for projects until the Flood Control Act of 1917 specifically authorized flood control on the Mississippi and Sacramento Rivers.

Originally the Commission's jurisdiction over surveys and investigations extended to the headwaters of the Mississippi, while jurisdiction for construction work was limited to the Lower Mississippi from the mouth of the Ohio River to the Head of the Passes. Its jurisdiction was extended from time to time until by 1926 it had control over construction of flood control works on the main river to Rock Island, and on the tributaries for as far up as they influenced floods on the Mississippi.[4] All of the construction work supervised by the Commission was detailed to the Corps of Engineers.

For the most part, however, the Mississippi River Commission concentrated its efforts south of the Ohio River. It did investigate the possibility of using reservoirs on the Upper Mississippi tributaries as a means of flood control, and had they determined on this method of improvement, the Rock

Island District might have been in the flood control business much earlier. However, the Commission rejected reservoirs as too expensive and decided on levees as the primary method of fighting floods.

In the early years of improvement work, the Rock Island District took its limitation to navigation problems seriously. In 1884 people in the Sny Drainage District south of Quincy, Illinois, who had built a 50-mile levee requested reimbursement from the Government on grounds that the levee aided navigation by keeping the water within the channel. Colonel Mackenzie was requested to examine this levee to determine if it qualified, and on the basis of his report that the levee neither helped nor hurt navigation, the request was denied.[5]

Within 10 years, however, the increasing encroachment of the river bottoms by agriculture, industry and population heightened the need for flood control. Both the Corps and Congress softened their positions, and in 1895 the Rock Island District embarked on its first project which clearly included flood control as well as navigation improvement as its purpose: the Flint Creek Levee.

The River and Harbor Act of August 18, 1894, provided for a survey along the west side of the Mississippi River from Flint Creek to the Iowa River "with a view to improving the navigation by preventing the water from overflowing the natural and artificial banks along those parts of the river and deepening the channel."[6] The same act directed Colonel Mackenzie to make a survey of existing levees between Warsaw and Quincy, Illinois. Here a series of three levees comprised the Hunt, Lima Lake, and Indian Grave drainage districts built between 1881 and 1888. Recent floods had seriously weakened and breached these levees, and disagreements between levee commissioners had allowed further deterioration.

Over the next two decades the justification of levees as navigation improvements was used again and again in Congressional directives to the Corps

of Engineers, though it was evident that in water high enough to flood, no levee was needed to deepen the channel for boats.

In 1895 Congress appropriated $85,000 to repair and raise the levee from Quincy to Warsaw three feet above the high water of 1892. The same act appropriated $300,000 to construct a 35-mile levee between Flint Creek and the Iowa River. This was an earth levee with a slope of 3 to 1 on the river side and 2 to 1 on the land side, with a 4-foot width at the crown. The Flint Creek Levee was not only the first one constructed by the Rock Island District, it was also the last one built without cost-sharing by local interests.[7]

The levees at Flint Creek and Quincy were simply constructed of earth removed from borrow pits on both river and land sides of the levee. The borrow pits were located beyond a 20-foot shelf on which the levee sat, but within the 100-foot strip of land owned by the levee district. Levees averaged 7 feet high. Where they were subjected to the action of current or waves they were revetted; elsewhere grass and weeds made a thick mat. The only equipment used in the construction of these levees was a scraper.

More complicated problems arose over drainage of water impounded behind the levees when the river reached flood stage. This was not a serious problem in 1895, however, since both of the levees were in rural areas; it was handled by the installation of holding ponds and pumping stations.

Following these two levee projects, the Rock Island District did very little levee work for the next 30 years, aside from a minimum amount of work on drainage problems caused by the pool behind the Keokuk Power Dam. Not until the disastrous flood of 1927 did the Corps become active in outright flood control projects.

The 1927 flood dramatized the Engineers' inadequate program of improving navigation on the main streams while overlooking the impact of the tribu-

taries. An argument had been building among various groups over the best method for dealing with floods. Some groups wanted levees, others wanted dams, yet others wanted reservoirs. Out of this confusion, and based on cost estimates for comprehensive surveys which Congress requested of the Corps in 1925, grew the River and Harbor Bill of 1927 in which Congress authorized comprehensive examinations and surveys of the inland waterways by the Corps of Engineers in order to formulate

> general plans for the most effective improvement of navigable streams and their tributaries for the purpose of navigation and the prosecution of such improvement in combination with the most efficient development of the potential water power, the control of floods, and the needs of irrigation.[8]

These were the famous "308 reports," so called because the reports submitted by the Corps were printed as House Document 308, which became the point of departure for most basin-wide, multipurpose water resources planning in the United States. The Tennessee Valley Authority Act of 1933 made that the pilot basin based on these surveys.

Following the 1927 flood, the Mississippi River Commission requested the Rock Island District to assist with levee rehabilitation as far north as Rock Island. These were the first flood control projects in the District which did not come under the guise of "navigation improvement."

The Flood Control Act of June 22, 1936, put flood control more definitely under the supervision of the Corps of Engineers. This act is usually considered the beginning of full-fledged flood protection work by the Corps. The same act put responsibility for water flow retardation and soil erosion prevention under the Soil Conservation Service of the Department of Agriculture.

The Flood Control Act of 1936 authorized 14 individual flood control projects in the Rock Island District. Most of these were in agricultural drainage districts downstream from Rock Island, and included work at Keithsburg, Henderson, South Quincy, the Sny Island Levee District, and the Rock River

Basin. Congress did not authorize money for these projects, however, and no actual work was done in 1936.

As another provision of the 1936 act, Congress formally adopted benefit-cost analysis as a means of determining feasibility, although this had long been an informal policy for earlier Engineer projects. Section 1 of the act stated:

> The Federal Government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds thereof, for flood control purposes if the benefits to whosoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected.[9]

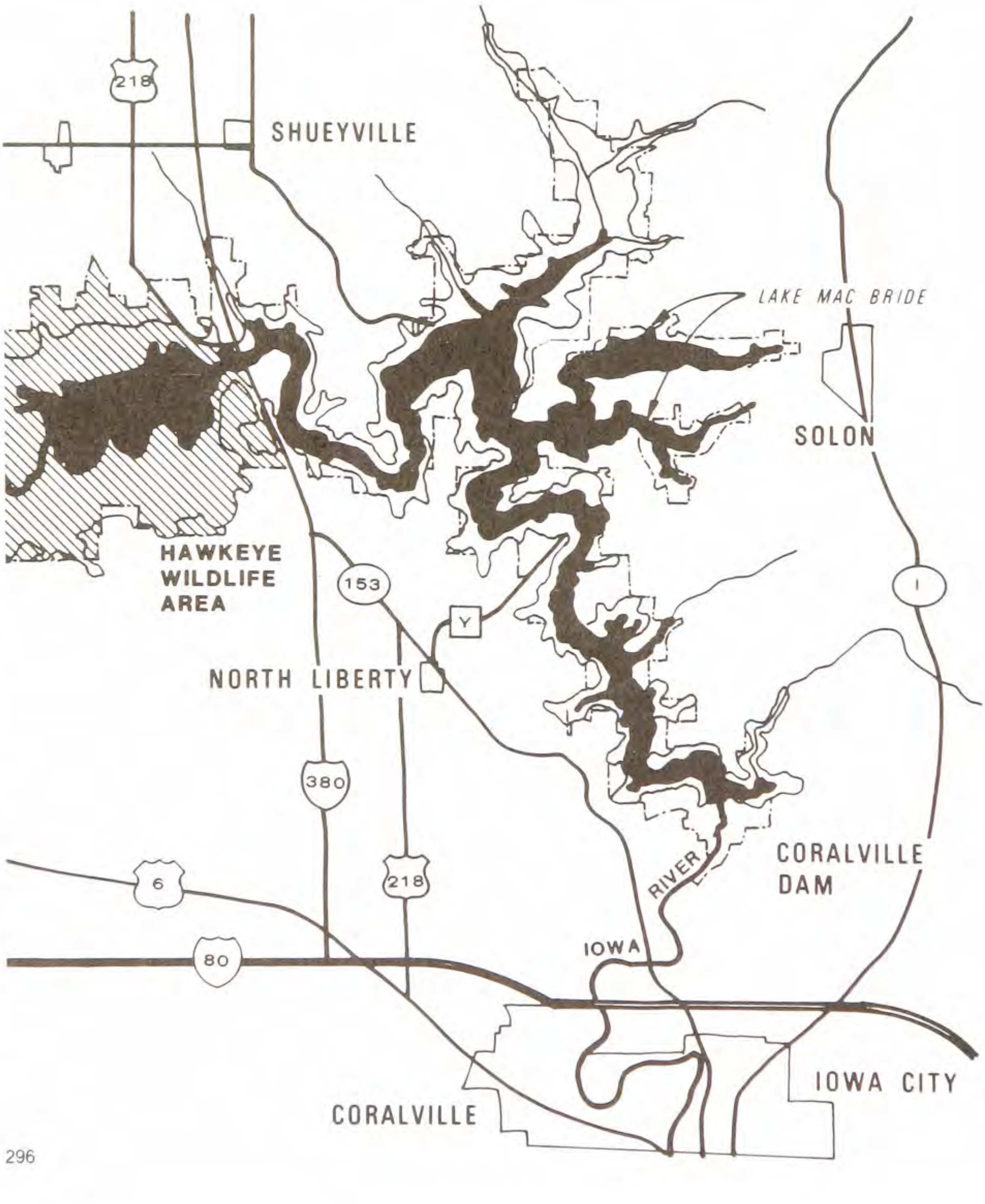
Little work was done in the next two years, with only $4,000 worth of work in the District to 1938, but with the Flood Control Act of 1938, flood protection was on its way to becoming the main activity of the Rock Island District. That act included the first provisions for Coralville Reservoir.

Reservoirs. The idea of controlling the flow of the Mississippi River by a series of reservoirs to impound excess water from spring floods and snow melt was a recurring idea since the 1850's when Abbott and Humphreys investigated that possibility as part of their hydrographic survey. In 1868 Major G. K. Warren, as part of his examination of the Upper Mississippi and its tributaries suggested a reservoir system at the headwaters of the Mississippi, not to control floods, but to increase the flow of the river between Minneapolis and Lake Pepin during the low water season. His 1870 report expanded this recommendation to 41 reservoirs on the St. Croix, Chippewa, and Wisconsin Rivers, as well as on the Mississippi.[10] Humphreys, however, continued to oppose reservoirs, and his successors followed him in considering them either too expensive or of little value to control flooding. Eventually, between 1881 and 1895, five reservoirs were constructed on the Mississippi headwaters in northern Minnesota, and a sixth was added in 1913. While they were partially successful in aiding navigation for 40 or 50 miles downstream, they aided even more the milling interests in Minneapolis who used waterpower to run their mills.

If the main stem of the Mississippi had been the major cause of flooding north of St. Louis, perhaps reservoirs would have remained too expensive and impractical, but flooding in the Upper Midwest came as much from the tributaries as from the Mississippi. The Rock, Iowa, and Des Moines Rivers were capable of causing extensive flood damage to towns along their own banks before swelling the main river with their flood waters. Further, low water was even more of a problem on these rivers than on the Mississippi. On the main river, low water hindered navigation, but low water on rivers such as the Des Moines reduced the water flow so much as to affect water quality for those towns which took their water supply from the river. Low water also adversely affected fish and wildlife and reduced both industrial and recreational use of the stream. On such streams, reservoirs would be of benefit as much during low water as during floods.

In a comprehensive plan for flood control, the Flood Control Act of 1938 authorized $2,700,000 for local flood protection on the Mississippi and Illinois Rivers, and $6,000,000 for reservoirs. The act specifically made provisions for a reservoir at Coralville on the Iowa River just north of Iowa City, as one of the projects selected and approved by the Chief of Engineers. The estimated cost was $4,999,000.

Extensive field surveys began at a tentative site in 1939 to determine land damages and remedial work which would be required, and to collect data for general hydraulic, hydrological, economic and flood routing studies. District engineers drew the first plans during 1940, which provided for construction of an earth fill dam, 1,400 feet long at the top, rising approximately 95 feet above the stream bed, with a reservoir providing for controlled storage of 400,000 acre-feet. An outlet works was to be located adjacent to the left abutment, with a controlled spillway on the right abutment. Discharge from the spillway (which would occur only during extreme flooding) reentered the river 900 feet downstream from the toe of the dam. In fiscal 1940, $146,163 was spent on the project.[11]



218
SHUEYVILLE
LAKE MAC BRIDE
SOLON
HAWKEYE
WILDLIFE
AREA
153
Y
1
NORTH LIBERTY
380
CORALVILLE
DAM
RIVER
6
218
IOWA
80
IOWA CITY
CORALVILLE

A map of the extensive Coralville Reservoir project, first of the flood control reservoirs constructed by the Rock Island District.

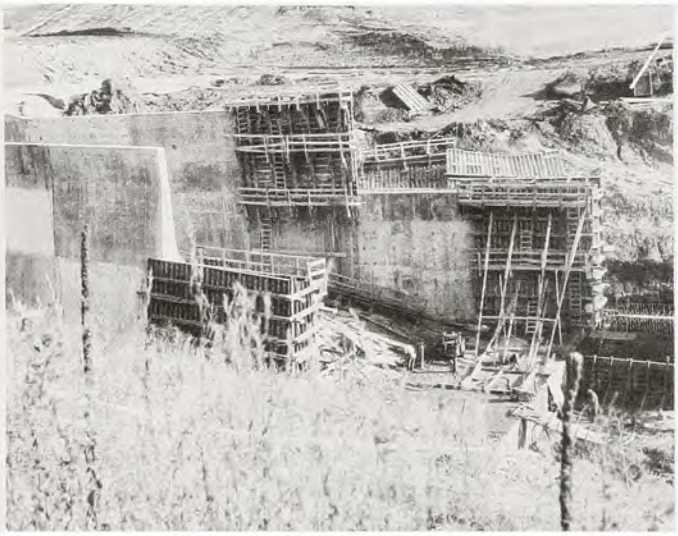
World War II brought civil works in the District to a standstill before any actual construction had begun at Coralville. Throughout the war only minor attention was paid to the project. In 1944 engineers considered alternate sites; in 1945 $29,000 was spent for surveys and reports (the largest single item of any civil project in the District in 1945). By the time construction began in 1948, the revised cost estimate had reached $14,089,000.

Meanwhile, District personnel were involved in flood fighting during major floods on the Des Moines River in 1944, 1945, and 1946. The Flood Control Act of 1944 expanded District flood activities in several directions.[12] It authorized the creation of Red Rock Reservoir on the Des Moines River south of Des Moines, with a total capacity of 1,200,000 acre-feet, which replaced a reservoir projected earlier at Howell. The 1944 act also authorized the first major urban flood control project in the Rock Island District; improvement of the Des Moines River through the city of Des Moines. The Act appropriated $10,000,000 for flood control in the Upper Mississippi basin, including the Red Rock Project.

The Flood Control Act of 1944 for the first time authorized the Corps of Engineers to provide for recreational facilities at its projected sites and to contract for the sale of surplus water for domestic and industrial purposes. This latter provision primarily affected Corps projects planned for the arid and semi-arid Western states, but the provision for recreation was to have an important impact on the responsibilities of the present Rock Island District at the reservoirs and elsewhere.

The 1944 act made one important change in procedure: it required the Corps to submit proposed project plans to each affected state for official review.

The original plans for Red Rock Reservoir called for an earth-fill dam with a crest elevation of 814 feet above sea level and a length of 1,000 feet. In accordance with provisions of the 308 Reports of



The beginning of dam construction at Coralville Reservoir.

Riprap operation on the upstream slope of the Red Rock Reservoir dam.

Construction of the outlet works at Saylorville Reservoir.

An overview of the completed facilities at Coralville.

1927, engineers planned a powerhouse with a capacity of 8,600 kilowatts as part of the project. Of the planned volume of 1,200,000 acre-feet, 800,000 was designated for flood control and 400,000 for power and recreation. The estimated cost of the project in 1944 was $20,710,000. By 1948 this had already risen to $53,000,000.

In 1946 Congress, continuing its growing interest in inter-agency cooperation, gave the Fish and Wildlife Service broad powers of consultation where alteration of natural stream conditions were contemplated.[13] District personnel have worked especially close with this group during planning and construction of the reservoirs.

Construction of Stage 1 of the Coralville project finally began in 1949 with site clearing, construction of field office buildings, and erection of the earth embankment portion of the dam. Stage 1 was finished by 1950 and work began on the outlet works. At this point both Coralville and Red Rock felt the effects of yet another war: the Korean conflict. During 1953-54, civil works in the Rock Island District fell to a low ebb. Construction on Red Rock had not yet begun and no funds had been appropriated for it, and in 1954 it was placed under "inactive flood control projects."

Work on Coralville Reservoir resumed again in 1955 with Stage 3, spillway and completion of the embankment. The Iowa River was diverted through the outlet works in June 1956, and in February of 1958, Coralville began operations for flood control, providing protection for 1,703 square miles of land along the Iowa River below the dam. As with the other reservoirs, Coralville also provides low water protection. The normal flow of the Iowa River is 1,607 cubic feet per second, but it has reached as much as 42,500 cubic feet per second at Iowa City during the record flood of 1918, and as low as 29.6 cubic feet per second, reached in October of 1916. Water is stored in the reservoir during high water and released during low water to even the flow of the river as much as possible.

As finally completed, Coralville Reservoir created a 4,900-acre lake that extended for 21.7 miles up the Iowa River above the dam. This permanent lake contains about 53,750 acre-feet at the normal pool elevation of 680 feet above sea level. Coralville Lake is kept at this level, excepting abnormal conditions, from June 15 to September 25, the recreation season. The level of the lake is raised 3 feet from September 25 to December 15 to send additional water into a 13,000 acre "Hawkeye Wildlife Area" managed by the State of Iowa at the upper part of the project. On February 1 each year the pool is lowered to 670 feet above sea level for four months to handle anticipated spring floods.

Water can be stored in Coralville Lake up to the spillway height of 712 feet above sea level. At full flood pool elevation the lake extends upriver for 41.5 miles and covers an area of 24,800 acres (compared to 4,900 acres for the permanent lake), containing 475,000 acre-feet of water.

The dam at Coralville is composed of two sections, an earth embankment 1,400 feet long and 22 feet wide at the top, built to an elevation of 743 feet above sea level; and a 500-foot-long concrete overflow section, the spillway, 712 feet above sea level. Under normal conditions, the water does not go over the spillway; rather, it is released through a 350-foot concrete conduit, 23 feet in diameter. Water flow is controlled by three control gates, each 8.33 by 20 feet.

In the same year that Coralville Reservoir was put into operation, the Flood Control Act of 1958 authorized planning for a supplemental flood control reservoir on the Des Moines River upstream from Red Rock Reservoir, about 11 miles above the city of Des Moines. This was Saylorville Reservoir, for which preliminary planning began in October of 1959.

The first construction money for Red Rock was appropriated in 1959, by which time estimates for the project had reached $75,200,000. Model tests of

the spillway were made at the U.S. Army Waterways Experiment Station in Vicksburg, and construction began in the summer of 1960.

Work on Red Rock continued steadily from 1960 until it was completed in 1969. Contractors built an impervious earth-fill embankment 110 feet high and from 680 feet wide at the base to a crown width of 44 feet. At the same time, extensive work went on to acquire the necessary land for the lake and to relocate people and structures. A total of 47,000 acres was purchased for the project. Within this area, portions of two towns and one unincorporated community had to be relocated above the flood control pool. In addition, the project necessitated the relocation of 42 miles of state and county highways, 96 miles of railroad track, 255 miles of electric power and telephone lines, two miles of natural gas lines, and eight cemeteries.

In naming this project "Red Rock" the Corps continued a policy of naming lakes after local communities. In this case, Red Rock was a historic and notorious village founded in 1843 beneath the red sandstone cliffs along the Des Moines River just across the boundary line between Sac and Fox Indian Territory and land newly obtained by the United States. Frequent floods and even more frequent violence had given the small village a reputation that lasted until the site disappeared under the waters of the new lake.

Red Rock Reservoir was completed on schedule in the summer of 1969 and dedicated on September 5-7. Unexpectedly, those attending the dedication saw Lake Red Rock at full elevation. An extremely heavy flow in mid-August had filled the reservoir to its permanent level of 725 feet above sea level in three days.[14] This was more than 40 feet over the planned level and resulted in an estimated savings of $6,000,000 in damages during its first 135 days of operation.

The permanent lake of 10,400 acres created by the dam is one of the largest lakes in Iowa. Lake Red Rock extends upstream from the dam for 11.3 miles

at a normal elevation of 728 feet above sea level. At full flood pool elevation of 780 feet above sea level, Lake Red Rock increases to 65,500 acres and extends upstream for 33.5 miles to the south limits of the city of Des Moines.

The dam at Red Rock is similar to that at Coralville, with an earth embankment 5,676 feet long and 110 feet high with a 658-foot width at the base. The concrete spillway section controls the flow of water with five Tainter crest gates each 41 by 45 feet. The normal water outlet is through 14 concrete conduits, 5 by 9 feet each. The final cost of Red Rock Reservoir to its completion in 1969 was about $85,000,000.

Red Rock serves three purposes, as do the other reservoirs in the system. Its major use is to control floods on the Des Moines River below the dam, and on the Mississippi River below Keokuk, where the Des Moines enters. Flooding on the Des Moines River was even more serious than on the Iowa River. Severe floods had caused extensive damage in this region in 1851 and again in 1858. Flooding in 1903 caused 8,000 people to evacuate their homes in Ottumwa, Iowa. Three severe floods in 1944, 1947, and 1954 had caused $51,000,000 in damages to towns such as Ottumwa, Eddyville, and Eldon, and to thousands of acres of farmland. The June 1947 flood, one of the worst in Iowa history, flooded large sections of Ottumwa and caused more than $30,000,000 worth of damage. Since its completion in 1969, Red Rock has prevented flood damage in excess of $29,000,000, primarily from severe floods in 1969 and in 1973.

The second purpose of Lake Red Rock, as with Coralville Lake, is to supplement low water on the Des Moines River with enough water to maintain a flow of 300 cubic feet per second at Ottumwa in order to provide good water for the many communities downstream who use the river for drinking and sanitation purposes. During the severe low water of 1977, the outflow did drop to 200 cubic feet per second to conserve all the water possible, but

even this was far better than the 30 cubic feet per second Ottumwa experienced during the low water of 1940.

In addition to flood and low water control, Lake Red Rock serves a large metropolitan area in central Iowa as a needed recreation site. More than 1,000,000 visitors annually use one or more of the recreational facilities operated or supervised by the Corps. Wildlife also benefits from the project. Together with the Iowa Conservation Commission and the Bureau of Sport Fisheries and Wildlife, the Corps developed thousands of acres of the project lands for intensive wildlife and waterfowl management.

The first plans for Saylorville Reservoir were drawn up in 1960 and called for a project estimated at $49,500,000. Saylorville was designed to supplement the water-storage and water-releasing capacity of Red Rock Reservoir and specifically to protect Des Moines from high water. Plans called for a rolled earth embankment 6,050 feet long extending from bluff to bluff across the valley floor of the Des Moines River at a maximum height of 125 feet.

Construction of the earth dam at Saylorville began in 1965. The spillway and outlet works were completed in 1970. The project was originally scheduled for completion in 1975, but in 1972, before the final stage, completion of the earth embankment, was finished, conservation and environmental groups caught up with the project and had it halted by the courts pending completion of an environmental impact study. Such studies are now a standard part of all preliminary surveys and examinations by the Corps, but Saylorville was planned before such studies were common. Environmental groups were especially concerned with the impact of impounded flood waters on Ledges State Park at the north end of the future lake.

As per court order, District personnel completed a final environmental impact statement and work at Saylorville resumed. The dam was completed in 1975, but was not put into operation, pending further studies and recommendations from both envi-

In addition to their primary purpose of flood control, the reservoirs serve a wide variety of recreational and conservation interests.

ronmental groups and the Corps. Finally, in 1976, Congress authorized a project modification to minimize the adverse effects at Ledges State Park. These modifications included the acquisition of an additional 2,200 acres of land between the dam and the city of Des Moines for use as a green belt to allow the earlier release of flood water and a consequent lessening of the flooding at Ledges.

After 12 years of construction, the flood gates at Saylorville were lowered into position on April 12, 1977. The occasion was marked by a ceremony that morning led by Rock Island District Engineer Colonel Daniel L. Lycan and Iowa Congressman Neal Smith. Extremely low water during the 1977 spring and summer slowed the filling process. Not until September 9, 1977, was the normal lake level of 833 feet above sea level reached.

As finally completed, the dam at Saylorville Lake is an earth embankment 6,750 feet long at its crest and 105 feet high. A 430-foot-long concrete spillway is located at the west bluff, with a crest 31 feet below the earth section of the dam, or 884 feet above sea level. The structure is a chute spillway with an uncontrolled concrete weir. Flood water flowing over the spillway ends in a concrete stilling basin and then flows through an excavated pilot channel to the river. Under normal conditions water is released through a 22-foot-diameter concrete conduit through the base of the dam, with the flow controlled by three electrically operated gates in a control tower. At the normal lake level of 833 feet above sea level, Saylorville Lake extends upstream for 17 miles and covers 5,400 acres. Under maximum flood storage conditions, the impounded water extends upstream for 54 miles over 16,700 acres, with a volume of 602,000 acre-feet. The reservoir holds the flood waters of a 5,823-square mile watershed.

Several other sites for reservoirs have been examined over the past years, but the only remaining reservoir to reach the planning stage was on the Skunk River north of Ames, Iowa. This project was placed in an inactive category in June 1974 because of state and local opposition.

At Saylorville, as at the other two reservoirs, recreation has become the guise by which most people have come to know the site. By 1980 more than 2,000,000 people annually were using the Corps' supervised facilities at Saylorville Lake. At the five major recreation areas established by the Corps, modern campsites with full facilities, including several winterized sites, boat ramps, sandy beaches, and a well-stocked lake attract vacationers, nature lovers, and sportsmen. Together with Coralville and Red Rock, more than 5,500,000 people used the recreation facilities at the reservoirs in 1980.

Other Flood Control Measures. Following heavy floods in the spring of 1943 and again in 1944, Congress authorized a total of $22,000,000 to be appropriated as emergency funds disbursed by the Secretary of the Army and the Chief of Engineers for re-

pair, restoration, and strengthening of levees and other flood control works threatened or weakened by floods. This fund was supplemented by an additional $12,000,000 in 1945 and $15,000,000 in 1947. Of this sum, the Rock Island District received just over $350,000 for levee repair in 1944 and $749,461 for 47 levee repair projects in 1947. Funds from this appropriation do not need prior approval for each individual project, and are in addition to regularly authorized projects. Under this appropriation, the District continues to undertake several emergency projects each year. These may involve work during a flood or repair to flood control or navigation structures damaged by a flood.

Projects funded from regular appropriations have primarily been the construction or the bringing up to grade of rural and urban levee systems. By far the largest of the rural levee projects was the Sny Basin, authorized by the Act of July 24, 1946. Its estimated cost in 1946 was $6,477,000, but its final cost when it became operational in 1967 had risen to $13,822,605.[15]

The Sny was a former by-channel of the Mississippi in Pike, Adams, and Calhoun Counties, Illinois. The project was for reduction of interior flooding through a comprehensive system of retarding reservoirs, diversion channels, pumping stations, closing levees, and drainage culverts and aqueducts.

Work on the project was slow in starting and was slowed even further by the Korean conflict, but in 1954 Congress authorized construction or modification of 14 rural levee protection projects within District boundaries. These projects downstream from Rock Island involved 335 miles of levee construction to protect 325,000 acres of agricultural land along both sides of 200-mile stretch of the Mississippi River. All of these projects have now been completed, while others of a similar nature have been authorized on both the Mississippi and on many of the tributaries.

Presently, the Rock Island District is completing a study of all existing Corps projects in the levee

High water conditions in the Muscatine Island Levee District showing a typical rural levee system at work.

and drainage districts within its boundaries under a 1969 Congressional authorization. These studies will determine which projects, if any, warrant additional flood protection.

More visible than the rural levee systems have been the complicated urban flood control projects which have become a major part of Rock Island District responsibilities. The first major urban flood control project in the District was protection of the city of Des Moines from the Des Moines and Raccoon Rivers within city limits through the construction of levees and floodwalls. This project was authorized by the Flood Control Act of 1944, but construction did not begin until 1966. The project is now virtually complete.

A second major urban flood control project was authorized at Dubuque, Iowa, by the Flood Control Act of 1962. Situated on a narrow strip of land between the river, with bluffs stretching the whole length of the city, Dubuque was in many ways ideally located for flood protection. Urban flood control, however, poses far more intricate problems than rural levee systems. Dubuque was not only a dense urban area, it was still a community tied to the river. The Dubuque Ice Harbor was still used for industrial, commercial, and pleasure use. At other

places along the waterfront, industries depended on the river for their operation or had constructed buildings too close to the water's edge for a levee.

Construction of the Dubuque Local Flood Protection project began in 1968 after careful planning and testing by both Corps and contractors. In addition to sections of earth levee, the Dubuque project involved concrete and steel walls, closure structures, a navigation opening for the commercial harbor, and interior drainage facilities. The levee part of the project was completed in early spring of 1973 in time to show dramatic results in protecting Dubuque from the devastating 1973 flood.

Following completion of the levee system, work continued on the recreation facilities of the project, including public access to the riverside of the levee. Sidewalks and steps were located on the riverside to provide public access to the river for various kinds of recreation. Also as part of the project, a native

stone lookout tower, the Dove Overlook, was rebuilt, with access from the top of the levee. Along with the recreational facilities developed by the Corps, the city of Dubuque built two bicycle trails along the top of the levee. These recreational additions completed the Dubuque project and were dedicated on July 29, 1978.

Two other urban flood control projects were dedicated during the summer of 1978. The Rock Island Local Flood Protection project was a direct response to the 1965 flood, the worst in Rock Island's history. Although the project had received Congressional authorization in 1962, only small amounts of money had been allocated for preliminary studies prior to 1968. Even though the project faced the usual problems of land acquisition, of city cooperation in the removal of sewer, water, and electrical lines, and of aesthetic objections raised by some residents wherever any levee system was proposed, cooperation between city officials and District representatives was good and few major problems arose to slow the work. Construction on the Rock Island levee began in 1971 and was complete enough by 1973 to aid the city during the 1973 flood. The project was dedicated on June 24, 1978. To that point the project consisted of three and one-half miles of levee along the river built to 572 feet above sea level, or 7 feet above the crest of the 1965 flood. The cost was $9,600,000, of which $1,280,000 came from the city of Rock Island and the remainder from Federal funds. Since 1978 work has continued on recreational facilities in connection with the levee, including scenic overlooks, fishing access areas, a baseball field, shelter, and a nature trail. The third urban flood control project completed in 1978 was the project to protect Marshalltown, Iowa, from the Iowa River. The Marshalltown project was dedicated on July 15, 1978.

Three additional urban flood control projects are nearing completion: at Waterloo, Clinton, and Marengo, Iowa. The largest of these, the Waterloo local flood protection project, consists of a 17-mile system of levees and floodwalls. This project, begun in 1972 following Congressional authorization in

1965, will protect Waterloo from major flooding on the Cedar River and Black Hawk Creek at an estimated total cost of $48,830,000. Along with the levees and floodwalls, the Waterloo project includes eight pumping stations, ponding areas, closure structures for streets and railroads, changes in interior drainage facilities, a ring levee surrounding the Waterloo sewage treatment plant, and a small reservoir to hold the excess flood water from Virden Creek. The project at Waterloo is an especially good example of how an urban flood protection system can be handled with attention to aesthetics and recreation. The levee system runs through a section of downtown Waterloo scheduled for renewal and beautification by the city, and every attempt was made in the design of the levee to fit in with this plan. For example, the project includes sections of lowered floodwalls to give residents a better view of the river and of Waterloo's Recreation and Arts Center Building. During floods, closure panels will be used at these lowered sections. Another two-block earth section of the levee has been contoured into free-form hills. These "Mounds" as they are called, provide flood protection, but they also are pleasing to the eye. Another portion of earth levee has been shaped into an amphitheater facing the Cedar River for future use by the city of Waterloo.

At still other places along the project, concrete levees have been placed back to provide room for sidewalks, stairways, and park benches along the river's edge. The pleasing and imaginative Waterloo project was awarded an honorable mention in the engineering category in the 14th annual U.S. Army Chief of Engineers Design and Environmental Awards Program in 1979.

At Clinton, Iowa, the flood control project was authorized by Congress in 1968 and begun in 1974. It consists of two systems, one along the Mississippi River and Mill Creek and the other along Beaver Slough. The Mississippi section has been completed, and consists of 8.1 miles of earth levee and 3,080 feet of I-type concrete floodwall, as well as an interceptor sewer, pumping stations, closure struc-

tures, ramps, ponding areas, and gate wells. Work on the Beaver Slough segment of the project was completed in 1981.

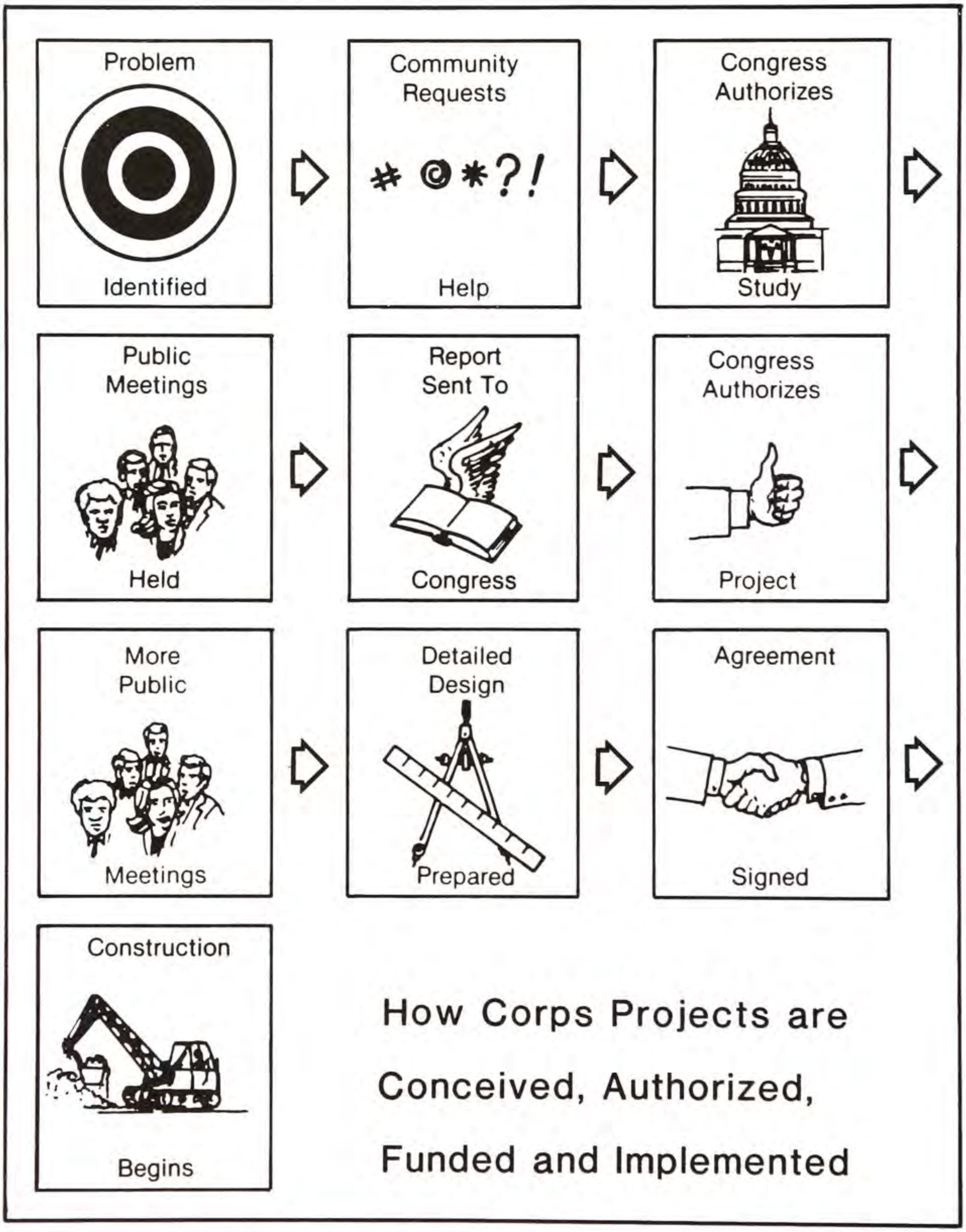
Several other lesser flood control projects remain in various stages of completion: the Fulton Local Flood Protection project begun in 1977; the Kent Creek Local Flood Protection project at Rockford, Illinois, begun in 1978; and the East Moline, Illinois, Local Flood Protection project begun in 1979.

In addition to local flood protection projects, the Corps of Engineers also performs several other flood-related services. Engineers are available on request from communities to serve as advisors during flood fighting activities. The Corps also maintains an information service to keep local news media up-to-date on flood information before, during, and after a flood.

The Flood Control Act of 1960 authorized the Corps of Engineers to develop and provide information about flood hazards to states and communities. The purpose of these flood plain information studies is to aid local governments in regulating flood plains so as to avoid or minimize future damage. A state or other responsible governmental agency must request these studies and agree to disseminate the final report, and the application for a study must be approved by the Chief of Engineers before the surveys and examinations are begun. More than 20 of these studies have been completed in the Rock Island District.

Procedures for Flood Control Projects.[16] The procedure by which a community obtains a flood control project is a complicated and long one, as can be seen from the many years which usually pass between authorization of a project and its completion. Critics of the Corps of Engineers are fond of suggesting that the Corps, looking for work to do, intrudes its will on community affairs in order to build unwanted levees. In fact, just the reverse is true.

The process which ends with a levee on the waterfront begins with a request from the people with a



How Corps Projects are Conceived, Authorized, Funded and Implemented

problem—local residents whose houses, businesses, or farms are being flooded. Community officials request help with their flood problems through their senators and representatives. One of these congressmen, in turn, introduces a resolution into the Public Works Committee of the House or Senate calling for the Corps of Engineers to study the feasibility of providing flood protection.

A chart showing steps necessary for a city or rural drainage district to obtain a flood control project.

These preliminary reports may be favorable or unfavorable to Federal involvement in the local project, but even if the studies are favorable, the movement toward a levee or floodwall is a complicated process taking an average of nearly 10 years—much longer if there are problems with funding or difficulty in obtaining community consensus. The process involves community meetings, many studies and reports in increasing detail, investigations of alternate possiblities and of such factors as impact on the environment, social impacts, and the effect of the project on the regional economy. The Corps of Engineers may favor one form of improvement over the other, but generally the local residents are presented with several alternative plans which vary not only in design but in expense and aesthetics. In most cases, an earth levee is the least expensive but the most obtrusive and obstructing. Once the possible options have been presented to groups of local citizens, who must share part of the cost, it is up to the local government to choose one of the alternatives or none. A visible indication of the different directions such negotiations can take can be seen in Davenport, Iowa, and Rock Island, Illinois, across the river from each other. Both cities were hard hit by the 1965 flood, and pushed for flood protection projects. Both went through much the same series of meetings, proposals and alternatives, but Rock Island officials were able to agree on what was needed, while Davenport, just as aware of the need for flood protection, remains deeply split on a number of critical issues. The process by which a community obtains a flood control project is illustrated on page 312.

Floods

Record-breaking floods occurred on the Mississippi River in 1951, 1965, and 1973. A comparison of these three floods illustrates how varied Mississippi floods can be. The wide drainage basin of the Upper Mississippi provides a range of factors which can form different combinations to cause different kinds of floods.[17]

The Flood of 1951. In an area as large as that of the Upper Mississippi basin, several conditions must coincide for major flooding to occur. Such a set of conditions occurred in April and May of 1951, resulting in a flood that exceeded the previous record flood of 1880 at nearly every location from Dubuque to the lower limit of the Rock Island District.

Warm weather toward the end of March combined with six major and several minor rainstorms throughout the District between April 1 and May 18 produced a prolonged period of flood stage on most of the upper Iowa and Illinois tributaries.

However, these conditions merely set the stage for the major contributing cause of the 1951 flood, a heavy snow melt during April from the central portions of Minnesota and Iowa. March was a wet month over the entire Minnesota River watershed, with an average 36 inches of snowfall, compared to a normal average of 8 inches.

Although the spring break-up during the second week in April did not extend up the Mississippi beyond the mouth of the Minnesota River, the melt in central Minnesota was rapid. The resulting flood on the Minnesota River was the most disastrous flood in Minnesota's history. Especially hard hit was Mankato, where the crest flow was about 50% greater than the previous record flow. In Wisconsin, the St. Croix, Chippewa, Black, and Wisconsin Rivers contributed to the flood.

By April 15, severe flooding was forecast in the Mississippi Valley. Water coming down the Missis-

sippi, combined with the April ice breakup and the water from storms and swollen tributaries produced a record flood.

The crest of this flood reached the upper end of the Rock Island District on April 21 and reached Dubuque the next day. At Dubuque the river stayed close to the crest level for five days. As the flood moved downstream, the crest lengthened, remaining at Rock Island for nine days, at Burlington for 14 days, and at Quincy for 16 days.

The seriousness of the flood became apparent about a week before it arrived. The Corps used this lead time to participate in several flood prevention measures. Mayors, representatives of business and industry, and others interested were invited to meetings at Dubuque, Clinton, and Rock Island, where representatives of the Corps discussed the impending flood.

Technical personnel from the Rock Island District were stationed in problem areas throughout the District during the critical flood period to give advisory assistance on emergency flood protection. In addition to the regular work force at the District Office who performed flood fighting as part of their normal work, 65 more personnel dropped their regular duties to participate in the District's flood activities.

The Corps assisted in many other ways as well: collecting rainfall, weather, and river stage information for local authorities; informing the Coast Guard, Red Cross, and other agencies of flood conditions, patrolling levees and other trouble spots. In addition, the District procured flood fighting equipment from its stock of materials. These included 375,000 sandbags. The total spent by the Corps on these emergency activities was $110,000.

Following the flood, the District made field observations of damages. Property and wage loss was particularly severe in the urban areas. Although the flood inundated many acres of farmland in the southern part of the District, it came at a time when there was little loss to crops and only a slight delay of the planting season.

Front Street in Davenport, Iowa, during the 1888 flood.

Several communities along the main stem of the Mississippi were hard hit, but nearly everywhere, existing flood protection works and additional emergency construction prevented even more serious damage. Towns like Dubuque where the flood stage exceeded the 1880 record by one foot could have been hard hit, except for the rapid construction of temporary dikes. Industries installed pumps and moved equipment to upper levels, so that while Dubuque experienced flooding of some low-lying residential areas, and had problems with its sewer system, damage was less extensive than it might have been.

The story was the same downriver. Only in locations where levee systems failed was there much damage. Two island communities at Campbell's and Smith's Islands had to be evacuated.

The Rock Island District's after-flood report put the total damages in the District, both rural and urban, at $9,403,900 along the Mississippi River, with

another $775,035 of damages along the tributaries. While 4,917 persons were displaced for shorter or longer periods of time, advance warning helped keep the loss of life to one, a drowning at Des Moines attributed to the flood.

An estimated $18,960,730 of damages was prevented by the advance warning and another $13,851,400 in damages was prevented by flood control projects—mostly rural levee systems—within the District.

The 1965 Flood. Less than 15 years after the record flood of 1951 the Mississippi Valley experienced an even more memorable flood. The flood of 1965 was one of the most severe floods on record from the headwaters area of Minnesota to the confluence of the Illinois and Missouri Rivers near St. Louis. It was the kind of flood those who lived through will tell their children about.

As with the 1951 flood, several necessary factors combined to cause this flood. Upstream areas of the Mississippi basin received above average rainfall in August and September of 1964. The ground was wet when the winter freeze-up occurred. In December the weather grew cold, causing deep frost penetration and rendering the ground impervious to the spring's melting snow and to rainfall. Rain in February and above-freezing temperatures during the month increased the water content of the snow cover. Finally, above normal snowfall occurred during March over the whole basin. The Weather Bureau at St. Paul recorded a total snowfall of 73 inches, compared to an average of 45-50 inches.

By the end of March it was apparent that a flood was coming. On March 31 the Rock Island District prepared a flood potential report. The impending flood was given wide coverage by the news media and once again, the Mississippi Valley began preparatory measures. During the first week of April the Corps established communications with threatened communities. A 24-hour surveillance was established and around-the-clock construction was begun at critical sites. As with the 1951 flood, District technical personnel were sent to critical areas.

Clinton, Iowa, during the 1951 flood. A Mississippi flood often hides the damage it does under a calm surface.

A chronology of flood-fighting efforts at Rock Island was repeated at towns up and down the river. On April 9 the U.S. Weather Bureau predicted a flood crest at Rock Island of 19.5 feet, 4.5 feet over flood stage. The following day Rock Island began strengthening and elevating its existing dike system. On April 12 the Mississippi rose an ominous 1.1 feet in 24 hours, and sandbag loading facilities were put into operation at the Mill Street incinerator. Representatives of the Corps, the city, and local business and industry met to discuss strategy should the dikes not hold.

On April 15 the Mississippi rose above the 15-foot flood stage at Rock Island, while heavy rains slowed work on the dikes and weakened them. By April 16 the Weather Bureau had revised its flood crest upward to 20.5 feet, causing concern that water would flood the city dump and drive rats to higher ground. Anticipating this, Rock Island increased rat poisoning efforts and set up typhoid innoculation centers.

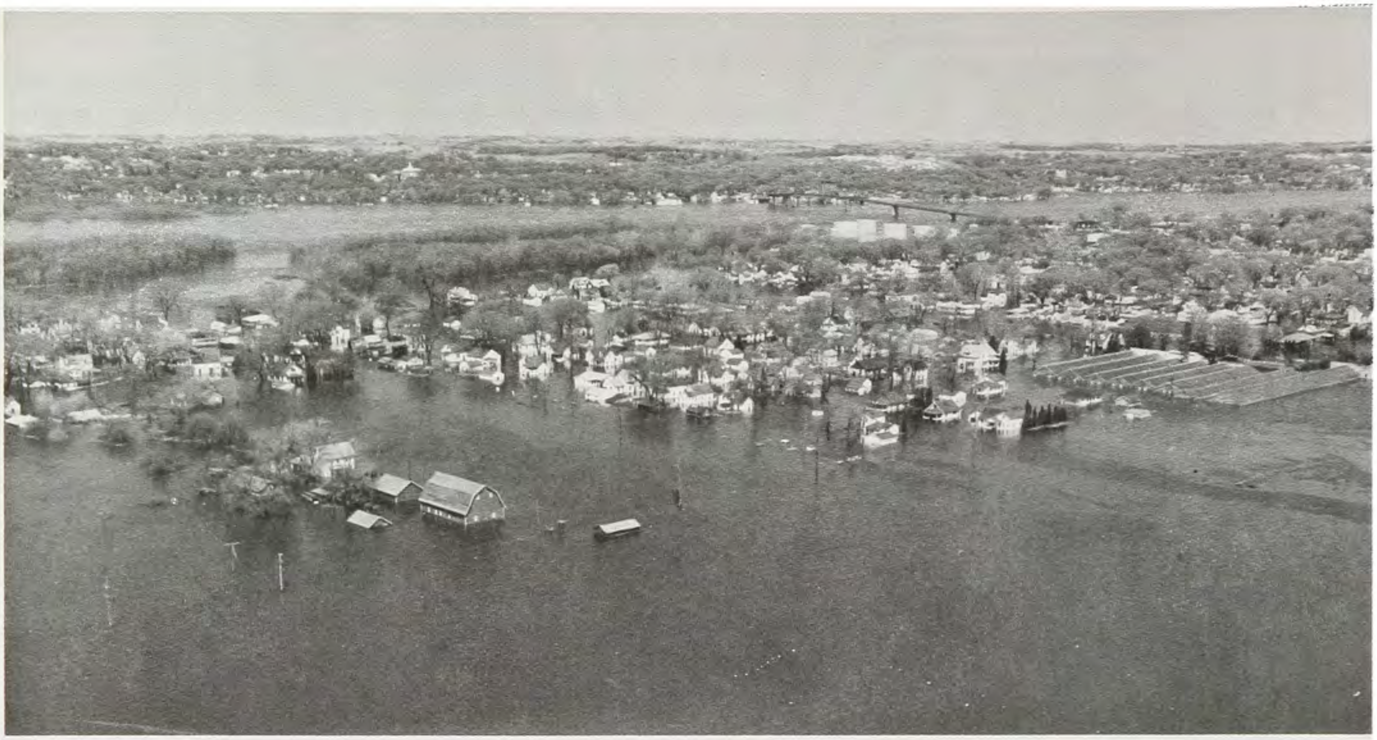
With the river stage at 15.9 feet on April 17, Rock Island officials requested more volunteers to shore up weak dikes and fill sandbags. As the river continued to rise, to 16.4 feet on April 18, to 16.7 feet on

April 20, to 17.2 feet on April 21, the Red Cross set up additional shelters, the Salvation Army began serving food to flood fighters, and the telephone company installed emergency phone service at potential flood spots. The Corps acquired 10,000 additional sandbags and established second lines of defense behind potential weak spots in the dikes. Meanwhile, crest estimates continued to be revised upward nearly every day, to 21 feet on April 20, to 21.5 feet on April 22.

On April 21 downtown Rock Island businesses began evacuating basements and sandbagging around their buildings. On April 22 the Rock Island Police went on 12-hour shifts, with all leaves cancelled, as 24-hour foot patrols on the dikes began. Illinois Governor Otto Kerner and Congressman Gale Schisler visited the flood protection works.

On April 23, with high winds and additional rain beating at the dikes, and the flood stage at 19 feet, the Red Cross set up an evacuation center at the Prince Hall Masonic Home. The following day Rock Island established evacuation headquarters at Rock Island City Hall as more than 2-1/2 inches of additional rainfall caused a revision of the flood crest to 22.5 feet. Several families were evacuated from low-lying areas and downtown businessmen were warned that the rain-weakened dikes would probably break in less than 10 hours. Additional second lines of defense behind weak dikes were built by flood fighters who worked past midnight to get the job done.

On April 25, with the river stage at 21.42 feet, a break in the dike near the Rock Island Boat Club flooded the sewage disposal plant, the Container Corporation plant, and Macombers. An appeal went out for more volunteers as the crest continued to rise. The next two days were the most critical. On April 26 the dike broke by the J. I. Case Plant and a new dike had to be built at Third Avenue. Schools were dismissed to provide additional volunteers to fill sandbags. For several days hundreds of high school and college students had already skipped classes to volunteer as flood fighters. Many




LINE'S
BOWLES
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SHOES
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CAUTION

teachers worked alongside the students or provided transportation from the schools to the flood site. Volunteers worked around the clock to build a new dike under Centennial Bridge to save the downtown from flooding. By April 26, flood water had reached Third Avenue at some points.

Fulton, Illinois, during the 1965 flood, one of the worst floods in the District.

On April 27 the river stage went over 22 feet and water began backing up through storm sewers. Sand boils developed behind the dikes, and 100,000 sandbags and thousands of cubic yards of clay were used to build a new dike. In addition to the Red Cross and the Salvation Army, many other organizations donated money, food, clothing, and time to aid flood fighting efforts. The Red Cross was taking care of 464 evacuees in temporary shelters.

At 11:30 on the morning of April 28 the Mississippi finally crested at 22.5 feet, but all dikes held. An emergency dike had to be built around the water treatment plant because of water seepage; however, the worst was over. April 29, with the river stage at 22.48 feet, the water began to drop — slowly. Still, volunteers and patrols continued their work.

The Mississippi at Rock Island reached a level 3.1 feet above the previous record. Indeed, over almost the entire length of the Mississippi, the flood crest attained record levels. The crest exceeded the previous maximum at Guttenberg, Iowa, by about 4 feet. Because of the record amount of flood water, the flood stages lasted longer than the 1951 flood, lengthening as the flood came downstream. At Dubuque the river rose above flood stage on April 1 and remained above for 26 days. At Hannibal, Missouri, the flood stage lasted 43 days.

Main Street in Hannibal, Missouri, during the height of the 1965 flood.

As with the 1951 flood, much damage was prevented by advance warning and preparations. However, with the water at stages significantly higher than those in 1951, problems were more serious and greater damage resulted. At Cassville, Wisconsin, where five homes had been touched by the 1951 flood, 69 residences were affected in 1965, forcing evacuation of 220 persons. At Dubuque, even though a 3½-mile dike was constructed after the

flood warning, extensive property damage occurred. The cost estimate for industrial and residential property in Dubuque was $2,060,000 in physical damages alone, with the total cost of the flood in lost wages, property damage, and flood fighting put at $7,654,000.

The story was repeated downriver: damages to streets, storm sewers, problems with sewage disposal, interruption of railroad service, dislocation of families. Towns like Fulton and East Moline, Illinois, experienced severe damage. At East Moline

Lock 21 at Quincy, Illinois, during the 1973 flood.

One of the worst ice jams on the Mississippi occurred in February 1966. The dark strips on the ice are coal dust, dropped from a plane by the Corps of Engineers in an experiment to hasten melting.

958 homes were partially destroyed and 2,537 persons had to be evacuated.

Only a few locations escaped with minor damage. Examples were Bellevue, where precautionary measures were taken, and Galena, Illinois, and Sabula, Iowa, where Corps of Engineers' local protection projects successfully withstood the record flood stage.

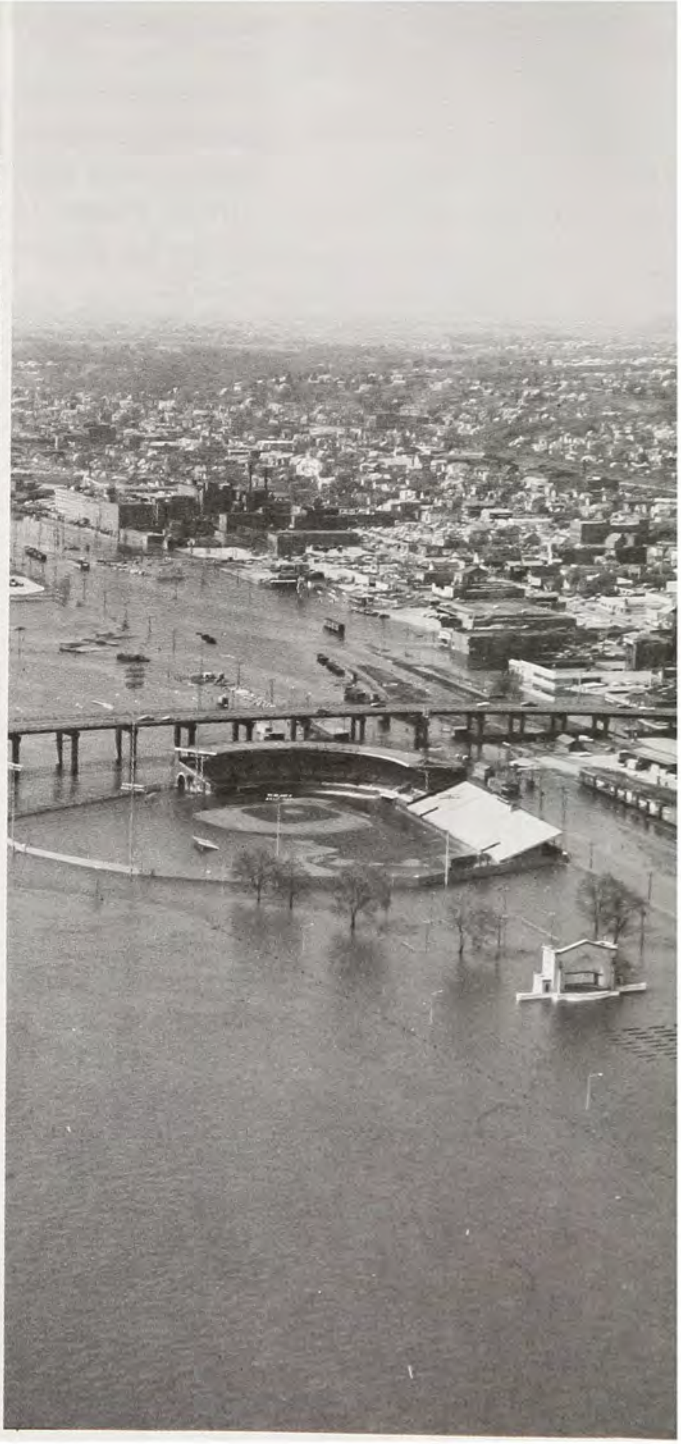
The 1965 flood caused more damage to rural areas than the 1951 flood had, but again, little actual damage to crops occurred because of the season. Most rural damage was to cabins and cottages extensively built up along the shores.

Final estimates of damages due to the 1965 flood put the total cost (property, lost wages, flood fighting) at $55,366,600. Of this, $37,633,700 was damage to urban areas. Although there were no deaths attributed to the flood, 12,956 persons were displaced. Expenditures by the Corps of Engineers in the Rock Island District amounted to $1,965,000. Although many communities experienced serious economic loss, the Corps' estimate of damages prevented due to advance warning was $174,394,600.

Between the 1951 and 1965 floods a number of flood control projects had been completed by the Rock Island District and a number of others had been authorized and were partially complete. District personnel estimated that one project alone, the Coralville Reservoir, prevented $1,500,000 in damages. The estimate of the total damages prevented by completed and partially completed flood control projects was $29,812,000. Had all of the authorized projects been completed in time for the flood, an additional $31,400,000 might have been prevented, including $10,000,000 to the city of Dubuque alone. The 1965 flood thus increased the awareness of many communities of the need for flood control.

The 1973 Flood. The 1973 flood was different from the 1965 and 1951 floods in that it was caused primarily by continuous rainfall which brought both tributaries and the main river to high flood levels.

The newly-completed Rock Island levee kept Rock Island dry during the 1973 flood.



Davenport, Iowa, just across the river from Rock Island, during the 1973 flood, with its flood control project still in the talking stage.

Rainfall in the first six months of 1973 was 220% of normal. Rainfall recorded during this period in Moline, Illinois, was 36.72 inches, or almost 4 inches more than the normal amount for a whole year. New monthly records were recorded in March and April.

The excess rainfall produced record stages on the Rock River in Illinois and on the Wapsipinicon, the Iowa, the Skunk, and the Des Moines Rivers in Iowa, as well as on several lesser streams.

Prior to the record rainfall of March and April, ice jams and above-normal stream flows caused moderate flood damage to several locations within the District. Throughout the Rock Island District the flood emergency situation extended from January 1 to June 1, except for a brief period in late February.

Because the tributaries were at such high flood levels, each tributary stream added large volumes of water to the Mississippi crest as it moved downstream, increasing the flood stages. That meant that at Davenport the 1973 flood ranked as the fifth highest on record, 3.5 feet below the 1965 crest, but from Burlington, Iowa, downstream, the 1973 surpassed all others. By the time the crest reached Quincy and Hannibal, it produced stages 4 feet higher than in 1965.

The 1973 flood stayed around for an unusually long time. The Mississippi was at flood stage at Quincy for 94 days and at Hannibal for 100 days. Because the flood was caused by several periods of rain rather than one large snow melt, it produced four major crests during this period.

Damage on the middle and lower sections of the Rock Island District was especially severe. Preliminary estimates showed about $410,000,000 in damages for the whole Mississippi, with about $60,000,000 of those damages occurring in the Rock Island District. For the first time in history, however, the Corps control measures prevented more damage than actually occurred. The District estimated that the flood protection projects already constructed in its area prevented an excess of $65,000,000 in damages.

In the period from April 22 to April 26, there were seven major levee failures within the District, inundating about 65,000 acres of farmland. Only one of these, in the Fabius River Drainage District in Missouri, was a Corps-built project. Along the entire Mississippi, the 1973 flood inundated 180,000 acres and displaced 10,000 persons.

Other Flooding. One other major cause of flooding has been a frequent problem in the Rock Island District: ice jams. Ice jams occur on the Upper Mississippi and its tributaries nearly every year, especially on areas of the Rock River. Although the majority of these jams happen in stretches of the river away from dense populations and relieve themselves naturally, they are capable of causing extensive damage.

During the winter of 1965-66 a serious jam occurred just downstream from Dam 15 throughout much of Pool 16. Warm weather in February and an uneven rock ledge bottom in this pool contributed to the backup of ice. Ice from the Rock River knitted into the mass already in the Mississippi and compounded the problem, raising the tailwater at Davenport and Rock Island above flood stage.

Engineers applied powdered charcoal, coal dust, and calcium chloride to the ice in an effort to weaken it, but the jam extended for 10 miles in the river, and only marginal results were produced. Finally, helped by rotten ice and rising temperatures, boats broke through the jam on March 1, 1966.

The ice jam caused flooding in several communities in the District and cost $900,000 in physical damages and flood fighting efforts. Davenport was the most seriously affected, with damage to about 150 homes. One benefit of the 1966 ice jam was the initiation of a Corps-wide program of data collection on causes and methods of relieving ice jams.

Low Water. Since 1973 there have been no major floods in the Rock Island District. While the Mississippi and its tributaries have reached or exceeded the flood stage at some point in the District almost

every spring, the natural conditions which bring on a record flood have not occurred. Further, the urban and rural flood control systems completed since 1973 have helped minimize damage to towns and industries. In 1979, for example, the operation of the three Iowa reservoirs was responsible for lowering the spring flood crest at Quincy, Illinois, on the Mississippi River by 2.8 feet.

Rather than flooding, low water has been the problem. During the 1976 and 1977 navigation seasons, a lack of water resulting from prolonged drought across much of the Upper Mississippi drainage basin hampered District operations. Low water created minor problems in 1976, but proved more severe in 1977 as the drought continued.

Fall rains in the Upper Mississippi basin were average in 1975, but winter snowfall in 1975-76 was below normal in most of the District, leaving little snow cover on the ground as spring approached. Some tributaries rose to flood stage and the Lower Des Moines River Basin experienced minor flooding as the result of rainfall during March and April; but following this spring runoff, precipitation fell again to well below normal, creating near record low river flows and levels from July until late October. On July 14, warnings were issued to commercial navigation regarding the low water. Commercial shipping was slowed, though not stopped, by the low water.

Drought conditions continued in earnest in the fall of 1976 as low rainfall established many new records. Precipitation for May through October 1976 was the lowest since 1894, with some localities receiving only half the normal amount. Continuation of the drought into the winter and spring of 1976-77 created additional problems. Both surface and subsurface water were below normal, and the lack of subsurface moisture permitted frost to penetrate as deep as 7 feet in some places. Many towns found their major water mains frozen. The lack of soil moisture also permitted strong winds to erode soil in an unprecedented manner, obscuring visibility on many days in central and northwest

Iowa. By the spring of 1977, 88 communities in the Rock Island District had experienced some municipal water shortage. Several community wells were completely dry. Above ground, the low temperatures and slow water flow permitted ice as thick as 24 inches to form on many streams.

In March 1977 Iowa Governor Robert Ray formed a Drought Emergency Task Force, which immediately sought advice from the Corps of Engineers. The Task Force requested Colonel Daniel Lycan, the District Engineer, to suggest actions to be taken during a drought. One immediate problem involving the District was the three Corps reservoirs in Iowa. By June the inflow to all three reservoirs had dropped to the point where they could not sustain their normal minimum release rate.

Low water may not seem as dramatic as flooding, but the problems it causes can be serious. In fact, the reservoirs were designed not only to impound flood water, but to maintain adequate stream flows during low water. Low water conditions affect wildlife habitats and can seriously affect the quality of water used by communities along a river for drinking and sanitation.

Throughout the winter of 1976 and through all of 1977, the Rock Island District carefully monitored the water flow in and out of the reservoirs to insure that water quality would be maintained downriver while storing enough water reserves in the pools. During June and July of 1977, the Corps cut the outflow from Coralville Lake from its normal 200 cubic feet per second to 75 cubic feet per second. Outflows from Lake Red Rock and from Saylorville Lake (which had recently been completed and was still slowly in the process of filling) were also reduced during the 1977 season.

On the Mississippi, the lock and dam system did what it was designed to do when it was built in the 1930's: maintain a 9-foot channel. Although some barges did have difficulty maneuvering the channel in the low water, and although the water flow was so reduced as to give Rock Island, Davenport, and

neighboring communities bad-tasting and bad-smelling water, the Rock Island District was able to maintain a 9-foot depth on the Mississippi with minimal hindrance to navigation.

The locks and dams have almost no effect on either lowering or raising flood levels. The system was designed to deal with the low water which regularly plagued the Upper Mississippi before the dams were built. The effect of the locks and dams can be seen by comparing 1977 to an earlier year with almost the same low water conditions: 1864. During the summer of 1864 almost no boats moved on the Upper Mississippi. From Winona, Minnesota, north there simply was no channel. People in the Rock Island-Davenport area were able to walk across the river between the two cities. Now, by maintaining a channel during periods of low water, the locks and dams not only keep commercial traffic moving, they also maintain fish and wildlife habitats that in former years would have dried up and been destroyed. With the levees and reservoirs to minimize flooding, and the lock and dam system to maintain a channel in low water, the towns and cities along the Mississippi today are more prepared to cope with the wild gyrations of the Mississippi River than were the same villages 100 years ago.

Notes

Chapter 11

1. Quoted in Fugina, *Lore and Lure of the Upper Mississippi River*, p. 308.

2. The 1917 act gave more responsibility to the Corps on the Mississippi and Sacramento (California) Rivers, but the 1936 Flood Control Act was the first to authorize specific projects.

3. *Report of the Federal Civil Works Program as Administered by the Corps of Engineers*, U.S. Army, pp. 263-64.

4. Arthur Frank, *The Development of the Federal Program of Flood Control on the Mississippi River* (New York: Columbia University Press, 1930), p. 134.

5. *Annual Report*, 1885, III, p. 1710.

6. *Annual Report*, 1913, p. 1881.

7. Richard Monroe, *Notes of Interest, Rock Island District, Wisconsin River to Clarksville* (Rock Island, IL: U.S. Engineer Office, 1935), p. 14.

8. 45 stat. 469. See J. P. Kemper, *Floods in the Valley of the Mississippi a National Calamity* (New Orleans: National Flood Commission, 1928), p. 170.

9. 49 stat. 1570. See Hubert Marshall, "The Evaluation of River Basin Development," *Law and Contemporary Problems*, 22 (Spring 1957), p. 241.

10. Raymond Merritt, *Creativity, Conflict & Controversy: A History of the St. Paul District U.S. Army Corps of Engineers* (Washington, D.C.: Government Printing Office, [1980]), p. 75. The St. Paul District history has a complete account of the reservoirs at the headwaters, and the political climate which surrounded them.

11. *Annual Report*, 1940, I, pp. 1193-94.

12. Flood Control Act of 1944. 58 stat. 887.

13. Edward Ackerman and George O. G. Lof, *Technology in American Water Development* (Baltimore, MD: Johns Hopkins Press, 1959), p. 496.

14. Rock Island District News Release, August 21, 1969.

15. *Annual Report*, 1970, II, p. 831.

16. Interview with Ray Stearns, Chief of Planning Branch, September 19, 1973.

17. Information taken from *Rock Island District Flood of April-May, 1951* (Rock Island: Rock Island District, Corps of Engineers, December 1, 1951); *Rock Island District Flood of April-May, 1965, Mississippi River* (Rock Island: U.S. Army Engineer District, Rock Island, June 1, 1966); and from preliminary notes compiled by the Planning Branch for a report on the 1973 flood.

Chapter 12
The Rock Island District Today

In 1966 the Rock Island District celebrated its centennial—one hundred years of improvement work on the Upper Mississippi River. The event was celebrated with a flair: speeches and special programs, a visit by the Chief of Engineers, Lieutenant General William F. Cassidy, a series of pamphlets and news releases designed to acquaint the public with Corps activities. The year 1966 found a District proud of the work it had done and confident of the future; a District vastly expanded beyond the old U.S. Engineer's Office in Keokuk and grown far larger than the several Engineer officers and their handful of civilian assistants who had supervised the first navigation improvements, but which had not outgrown the shared sense of purpose which characterized those early years.

The years since World War II, however, had not all been smooth. Following the exciting years of lock and dam building and the hectic rush of military construction under wartime conditions, a letdown was inevitable. For the Rock Island District this letdown was increased by the Korean conflict

when appropriations fell to a fraction of their former level. On two occasions during the 1950's, Rock Island came close to losing its Engineer Office.

On July 1, 1953, Colonel Nelson Leclair, Jr. arrived in Rock Island to become District Engineer. He had been transferred from the Office of the Chief of Engineers in Washington to supervise the possible closing of the Rock Island District.[1] An information leak occurred during the first part of July and rumors began to circulate that the District might be phased out.

There was some justification for review of the Rock Island District. Expenditures for new work in the District had fallen to lower levels than they had reached since prior to 1930. District expenditures fell below $1,000,000 in fiscal 1953, and to $250,000 during 1954. For these two years the only major item of construction was the new 1,200-foot lock at Keokuk, and work on this project was maintained only because failure of the old lock built by the Keokuk and Hamilton Water Power Company in 1913 would have interrupted navigation.

Several other Districts in the United States had greatly reduced work loads, and the review of the Rock Island District was part of a general study by the Chief of Engineers seeking to conserve expenses. There were indications that at least some of the duties in the Rock Island District might be transferred to the St. Louis District.

Had it not been for wide and immediate public support from residents of the Mississippi Valley, the Rock Island District very likely would have been dissolved. Congressman Thomas Martin of the First Congressional District in Iowa and Congressman Robert B. Chipperfield of the Nineteenth Congressional District of Illinois began meetings with chambers of commerce in the area and initiated several investigations in Washington. As a result of their efforts and those of such important rivermen as Chester Thompson, former mayor of Rock Island and president of the American Waterways Operations, Inc., a final decision to dissolve the Rock Island District was never made.[2]

In the fall of 1957 rumors again developed that the Rock Island District was to be merged with the St. Paul District, with headquarters at St. Paul. Again, quick and intensive action by local and national representatives served to postpone what would almost certainly have been the closing of the Rock Island Office. After a brief increase of activity and expenditure in the mid-1950's, Rock Island had dropped to the lowest workload of any Engineer district in the United States.

This time Senators Bourke Hickenlooper and Thomas Martin, and Congressman Fred Schwengel, all of Iowa, succeeded in getting a final decision postponed until after Congress convened in January.[3] Schwengel arranged a meeting in Rock Island with Chief of Engineers, Major General Emerson C. Itschner on December 9. At this meeting Itschner revealed that plans had been made to close the Rock Island Office, leaving a small work force of 35 people, but that due to the work of groups interested in keeping the office in Rock Island, the final decision had been passed on to the Secretary of the Army and his assistant.

The future of the District did not sound promising. Itschner felt that the most economical districts were those expending funds of between $15,000,000 and $20,000,000 a year. Projections for the Rock Island District were $5,500,000 for 1958, $3,800,000 for 1959, reaching only $10,800,000 by 1963.

Between the meeting with Itschner and the scheduled January hearings, Congressman Schwengel and others worked hard to assemble facts supporting the District. A Schwengel-led delegation met in Washington on January 28, 1958, with the Secretary of the Army. The result was that on February 5, Assistant Secretary of the Army Dewey Short announced that the present indefiniteness of flood control work in the Rock Island District made any move premature.

While the Rock Island District survived, it lost its dredge *Rock Island* which was transferred to the St. Lawrence Seaway project. It was never used on that

project, except that its presence helped keep contractors' bids low. Before it was transferred, it had been used in the District an average of 100 days each year. In its place, its sister dredge *Thompson* of the St. Paul District was assigned to cover dredging duties for both Districts.

Following the low ebb of 1957, District work rapidly picked up. While Red Rock and Saylorville Reservoirs and the Sny Basin project remained the major concerns, a number of small boat harbors were planned and constructed by the Corps at Warsaw, Quincy, and Moline, Illinois, and at other locations. Work also began on the first of the urban levee systems in the District.

By 1965 the District was engaged in 35 separate navigation and flood control projects. In pursuit of these projects the District expended $23,432,092 in 1965. In 1966, the District's centennial year, Congress appropriated $26,200,000 for projects in the District, almost $26,000,000 more than Colonel Wilson had to work with when he arrived in 1866.

For a third time fears that the Rock Island District might be scheduled for dissolution occurred early in 1979 as a nationwide Corps Organization and Realignment Study was announced on January 25. This time, however, while there were worries and rumors, there was no immediate concerted effort to "save the District" as there had been on the two previous occasions. Rather, both Corps employees and local interests listened to District Engineer Colonel Frederick W. Mueller, Jr.'s request to direct local effort toward "insuring that our input is factual, objective, and positive."[4]

Major General Richard L. Harris, North Central Division Engineer, studied Rock Island District's future in an examination encompassing the entire Division. Harris considered seven possible reorganization structures, ranging from dissolution of both the Chicago and Rock Island Districts along with transferring the St. Louis District to the North Central Division, to an enlarged Rock Island District with increased responsibilities. None of the likely

recommendations would leave the Rock Island District with exactly the same boundaries as it had.

On May 25, 1979, Harris recommended that the Rock Island District, rather than closing, be expanded to include the Illinois Waterway System. A final decision on that recommendation was made by the Chief of Engineers in November 1979, and the Rock Island District prepared to assume its new responsibilities and new personnel. On July 1, 1980, the river-related responsibilities of the Chicago District were officially transferred to Rock Island. These included the eight locks and dams, and the Illinois, Fox, Des Plaines, Kankakee, and Sangamon Rivers. It was this waterway system that had originally been part of the Rock Island District until 1877, when it was transferred to the Chicago District.[5]

The eight locks and dams and the two Corps project offices at Joliet and Peoria have added a field force of more than 270 persons to the District. The five locks built by the State of Illinois are old and in need of repair. The Rock Island District has already assumed major rehabilitation projects for two of these, at Starved Rock and Dresden Island.

Dredging is also a continuing necessity on the Illinois River, requiring an average of 500,000 cubic yards each year. Presently, the District is engaged in a study to determine the possibilities of re-channeling the mouth of the Sangamon River to prevent downstream silting of Muscooten Bay.

The Responsibilities of the Rock Island District

Flood control and channel maintenance remain the two major responsibilities of the Rock Island District. Flood control varies with the natural conditions and the number of projects under construction at any given moment, but channel maintenance is a steady and ongoing activity. With new river traffic records broken nearly every year, the lock and dam system requires constant upkeep and repair. Normal wear and the effects of ice, water, and loose barges mean that such repair work is almost constant. The District derrickboat *Hercules* is kept

busy for much of the year with emergency repairs and scheduled maintenance. Nearly every winter one of the lock gates needs to be lifted out by the *Hercules* for overhaul and painting. Many of the locks, now more than 40 years old, need concrete work as well. Upgrading is constantly taking place, too, with traveling mooring kevels being installed on the top of the lock walls to assist on the more and more frequent double lockages.

Although the roller gates which force the water under rather than over the dams do an effective job of keeping the channel free of sediment, dredging is still an important part of channel maintenance. The main channel on the Upper Mississippi winds from one shore to the other, around islands and sandbars, creating a number of trouble spots where sediment can build up. Since 1957, for a part of each season the Corps of Engineers' dredge *Thompson* belonging to the St. Paul District dredges in the Rock Island District. Normally the *Thompson* dredges upwards of 200,000 cubic yards each year in the District. However, the extremely low water and drought conditions in the District during 1976 and 1977 resulted in less sediment movement and in less need for dredging. In addition, the District, in discussions with the Great River Environmental Action Team formed in 1977, informally agreed to the minimum necessary amount of dredging until the environmental effect of dredging and disposing of dredged material could be studied. Previously, dredging had generally been done to more than the minimum 9-foot depth.

In 1975 the *Thompson* dredged 600,000 cubic yards of material at 10 locations. This fell in 1976 to 206,000 cubic yards at six locations, and to 66,000 cubic yards at three locations in 1977—the lowest amount dredged in the Rock Island District since the beginning of the 9-foot channel project in 1930. In recent years dredging has maintained its average 200,000 to 400,000 cubic yards per year.

Dredging by the *Thompson* has been supplemented by a small amount of dredging at several boat harbors by private firms under contract to the

Corps of Engineers, and by the derrickboat *Hercules* which is used to remove rocks and boulders. In addition, repair of wing and closing dams remains a part of normal channel maintenance.

The Rock Island District also undertakes, as needed, small flood control projects authorized under provisions of Section 205 of the 1948 Flood Control Act. These small (the Federal share must not exceed $2,000,000) local projects need only the approval of the Chief of Engineers instead of specific Congressional authorization. (If the President has declared the region a disaster area, the limit is $3,000,000.) In Rock Island District, small flood control projects are being studied or constructed in the cities of Burlington and Marengo, Iowa, and the Union Township Drainage District in Missouri. Under similar authority from the Chief of Engineers the Rock Island District has undertaken several small snagging and clearing projects for flood control, as well as emergency bank erosion control projects.

In 1974 Congress authorized the Chief of Engineers to establish a national streambank erosion prevention and demonstration program in order to evaluate methods of such prevention. Under this authority the Rock Island District constructed an experimental bank erosion project at Wapello, Iowa, in 1978, and is monitoring it for five years.

The Rock Island District also performs several non-navigation and non-flood control services. This has included such diverse activities as locating fallout shelters for the Civil Defense and procuring survey discs and specially formulated paints for the entire Corps of Engineers.[6] The bronze survey discs are used as boundary markers by all United States Army Engineer Districts and by the Defense Mapping Agency. The District obtains from 20,000 to 45,000 of these discs each year. Rock Island District also serves as the central procurement agency for paint used by the Engineer districts in the United States, obtaining between 40,000 and 70,000 gallons of special formulation paints each year.

Rock Island, in fact, originated the Corps paint laboratory in the early 1930's when engineers on the 9-foot channel project discovered that the conventional paints being used on the lock gates were lasting only an average of three years. The District Engineer asked the lab engineers to investigate better coating systems.

Under two District employees, John L. Rohwedder as chief of the paint lab and Fletcher W. Shanks as his assistant, the paint lab achieved dramatic results in a very short time. What began as a District project soon received divisional and then Corps-wide attention. Beginning in 1937 the Office of the Chief of Engineers supported the paint lab with funds through the Civil Works Investigation Program. A directive from OCE on May 22, 1953, improved the status of the lab and broadened its responsibilities, officially establishing it as the central paint laboratory for the Corps of Engineers.

The responsibility of the paint lab has been to "provide information to all districts and divisions on material, methods, and equipment which will give satisfactory protection at the least cost to civil works structures."[7] In an attempt to minimize the time span between paint research and development and government use, the paint lab evaluated potential coating systems, tested experimental coatings, and formulated paints for use throughout the Corps of Engineers. The paint lab also drew up specifications for paints to be submitted to contractors. Until 1973 the paint lab also conducted yearly training sessions at Rock Island for employees of other districts.

In 1972 the major duties of the Rock Island District Paint Lab were transferred to the Construction and Engineering Research Laboratory, the new Corps facility at Champaign, Illinois. By the end of 1973, all District responsibilities for paint research were phased out.

Surveys, Studies, Programs. During the past several years the Rock Island District has become involved in several special studies designed to reconcile man's varied needs with environmental considerations along the Mississippi.

In 1966 Congress authorized a Mississippi River Year-Round Navigation Study to determine the feasibility of extending the navigation season on the Upper Mississippi. The study concentrated on the area between Grafton, Illinois, and Cassville, Wisconsin, examining social, economic, engineering, and environmental aspects of the problem. The study was carried out mostly in the period since 1977, with a draft final report in June 1980 which recommended termination of the study.

The Upper Mississippi River Main-Stem Level B Study currently being completed by the Upper Mississippi River Basin Commission has brought together representatives of the St. Paul, Rock Island, and St. Louis Districts and other Federal, state, and local agencies to develop an integrated Federal-state-local perspective on our water and related land resources, together with a set of recommendations for planning and managing these resources, keeping in mind national economic development and environmental quality.

A similar but more local study began on May 17, 1977, to examine the long-range use of river resources: a $2,000,000, four-year project known as the Quad Cities Urban Study. Originating in the Federal Water Quality Act of 1972 and funded by Congress in 1974, the Study brought together representatives of the Rock Island District and the Bi-State Metropolitan Planning Commission (a planning agency for the five Iowa and Illinois counties around the Quad Cities of Rock Island and Moline, Illinois, and Davenport and Bettendorf, Iowa) to study water-related problems in the area covered by Bi-State. The study included flood damage reduction, flood plain management, water supply and conservation, waste water management, erosion, recreation, and fish and wildlife. The Study hopes to produce a master plan for the urban Quad Cities region good for the next 40 or 50 years. Corps participation in the Study ended with the completion of the intermediate planning level reached at the end of 1980.

GREAT II. In determining the best method for navigation improvement and flood control, the Corps of Engineers has tried to listen to all interested parties who have used or enjoyed the river. These have included not only commercial navigation interests, but conservationists, environmental groups, fishermen, and the population in towns along the banks. This was true in 1837 when Lieutenant Robert E. Lee arrived as a young officer to supervise the first improvements on the Upper Mississippi, and it was true when input from several groups resulted in the use of roller dams rather than conventional dams on the 9-foot channel project.

As use of the river by all of these groups has increased, however, each new decision about water use becomes more complex. Each additional use more closely affects other users. Responding to this increased complexity, Congress in October 1974 authorized a comprehensive study of the resource management problems on the upper reaches of the Mississippi. This effort was quickly expanded to include the entire Upper Mississippi River when Congress authorized the Great River Study in Section 117 of the Water Resources Development Act of 1976.

To carry out the study, groups known as Great River Environmental Action Teams were formed. Under the acronym GREAT I, II, and III according to the section of the river they were assigned, the teams were made up of Federal and state agencies, together with public interest groups and private citizens, operating under the jurisdiction of the Upper Mississippi River Basin Commission.

The three GREAT teams covered the entire Upper Mississippi. Of these, GREAT II was assigned to the area from Guttenberg, Iowa, to Saverton, Missouri (the limits of the Rock Island District), under the jurisdiction of the Rock Island District Engineers. Members of GREAT II included the states bordering the Mississippi (Wisconsin, Iowa, Illinois, Missouri), the Corps of Engineers, the U.S. Fish and Wildlife Service, the Environmental Protection Agency, the Soil Conservation Service, the

Department of Transportation, and concerned private citizens.

GREAT II was actually organized by the Rock Island District Engineer in 1975 and began planning in 1976 with funds provided from the Operations and Maintenance budget. When specific Congressional authorization and funding were provided in 1976, the GREAT II completed a plan of study which was approved at the quarterly meeting of the Mississippi River Basin Commission in June 1977.

While the major objectives of the GREAT study were to formulate for Congress a river resource plan that was comprehensive, practical and economically sound, and socially and environmentally acceptable, and above all, workable, the GREAT II turned its attentions first to the problems associated with maintenance channel dredging and the placement of dredged materials which might affect fish and wildlife habitats. During July 1977 the GREAT II formed a task force which participated in the Rock Island District's annual dredging program, inspecting dredged areas and disposal sites together with District personnel. In addition, during the summer of 1977, infrared photos of the Mississippi were taken to identify potential commercial-recreation conflicts and potential needs.

One of the main goals of the GREAT II program was to involve the public. To this end, members of the team produced a 20-minute slide show and printed a GREAT II brochure for use at public information meetings. Between September 19 and 28, 1977, the team held six public meetings at major river cities in the District. In addition, the GREAT II Information Coordinator made riverfront stops in the District in an effort to create public interest in the program.

The final report of GREAT II in 1981 divided its recommendations for a river management plan into nine components, each in a separate report. These include channel maintenance, which focuses on the procedures of the Rock Island District in disposing of dredged material; commercial transportation,

which seeks to improve both the safety and efficiency of river traffic; commercial, industrial and utility, which provides guidelines for continued industrial operation in a way that is protective of the environment; flood plain management, which deals with the inconsistencies in flood plain regulations and laws; recreation, which seeks to promote recreation on the Upper Mississippi; water quality, which provides guidance to agencies who deal with water quality criteria; sediment and erosion, which proposes programs to reduce erosion from upland soils; fish and wildlife, which seeks to document adverse impacts of human encroachments on fish and wildlife resources; and cultural and aesthetic, which recommends ways of protecting the region's cultural resources.

Hydropower Studies - Mississippi and Illinois Rivers. Another study in which the Rock Island District is presently engaged comes in response to another contemporary problem: energy. With energy needs growing and energy sources apparently diminishing, Congress, in Section 167, Public Law 94-587, of the Water Resources Development Act of 1976, authorized the Chief of Engineers to examine ways of using the existing Corps water resources projects, including locks and dams and reservoirs, for hydroelectric power. President Jimmy Carter on his trip down the Mississippi River in the summer of 1979, also noted the potential of the energy stored in the pools of the locks and dams. Later, he said "it is clear that various Federal dams, locks and other water projects would be suitable sites to be harnessed to produce hydroelectric power . . . I intend to see that this national resource is utilized."[8]

The Corps of Engineers National Hydropower Study has tentatively identified 11,000 existing dams and other sites that deserve further investigation. Though most of these are small-scale sites, many of them have the potential to add significantly to the nation's energy resources. The Rock Island District contains 20 of these sites with hydroelectric potential, including 16 locks and dams and all three Iowa reservoirs. The Corps has the authority to examine all of these sites.

Studies and examinations of the first five sites are already under way, and two others have just begun. Reconnaissance reports for Lock and Dam 14 were completed and similar reports for Locks and Dams 11 and 22 were begun in 1980. Under the authority of Section 216, Public Law 91-611, of the River and Harbor Flood Control Act of 1970, reconnaissance reports for the Starved Rock and Marseilles locks and dams on the Illinois Waterway were also completed in 1980. Reconnaissance reports had already been completed by the Chicago District on the Dresden Island and Brandon Rock locks and dams, and the Rock Island District is presently completing Detailed Project Reports for these dams.

Lock and Dam 14 was chosen as one of the first sites to be studied in the Rock Island District because it lies close to existing power lines and because the dam was constructed, as was Dam 15 at Rock Island, with provisions for hydroelectric power. It lacks only the machinery. While the five sites currently under study are capable of generating more power than the hydroplant at Dam 15 which has been generating power to operate the lock and dam machinery since 1934, none is capable of large scale energy production. Nevertheless, as the nation's energy resources dwindle, sending costs upward, the low-maintenance, fuel-free hydropower units may well became an important part of the responsibilities of the Rock Island District. Preliminary studies of the Brandon Road Dam with its head of 34 feet, for instance, show that four hydroturbines would produce 70,000,000 kilowatts a year, or enough electricity for 9,000 Chicago area homes.

In addition to the sites currently under study by the Corps of Engineers, Red Rock Reservoir is being examined as a potential hydropower site by the State of Iowa and the Iowa Power and Light Company.

New Directions

As the Rock Island District entered its second century of improvement work on the Upper Mississippi in 1966, it looked back with satisfaction on its

accomplishments, but it also looked forward to new responsibilities and directions. In the first 15 years of its second century, the District has become especially visible in the areas of recreation, regulation, and environmental concerns. While none of these is a new venture for the District, the emphasis given to each of them is recent.

Recreation. When the Federal Government acquired land along the Upper Mississippi in the early 1930's for the 9-foot channel project, it intended that some of the unflooded portions be used for conservation and recreation. Recreation concerns received further impetus from the Flood Control Act of 1944 which provided specifically for the development of recreation at Corps project sites. In the beginning, such recreation sites were often primitive, consisting of boat launching areas, public access areas along the river, and minimal campsites where the Corps cut up driftwood for fires.

Gradually, however, the 26 Corps of Engineers recreation sites along the 314 miles of Mississippi in the Rock Island District were upgraded. Today, many of them provide modern camping, fishing, and picnicking facilities, including pressurized water systems and modern sanitary facilities. For the past 10 years, from 700,000 to almost 2,000,000 people each year have used one or more of these 26 sites. Typical of these modern sites is the Thomson Causeway Public Use Area. Its 66 acres contain 125 campsites served by two shower buildings with hot water and flush toilets, as well as a large picnic shelter with fireplaces. A prairie restoration area and the Hidden Slough Nature Trail, as well as regularly scheduled interpretive programs by Corps rangers, provide entertainment and education for both campers and the day use picnickers during the May 15 to September 15 recreation season. More than 84,000 visitors made use of Thomson Causeway during 1981.

Yearly improvements are continuing at many of the sites, and are aimed at providing good, varied recreation while preserving or even enhancing the natural beauty of the environment. In 1980 the Mis-

sissippi River recreation program obtained its first fulltime Corps of Engineers interpreter who visited the Corps campgrounds along the river, presenting programs to more than 2,200 campers on topics which ranged from rope tricks and square dancing to edible plants.

Recreation at the three reservoir sites, constructed more recently than those sites along the river, are even more modern and sophisticated. Lake Red Rock's recreation program is a good example of the imaginative planning now carried on by the Corps. In addition to the usual recreational facilities such as playground equipment and hiking trails, and a lake stocked by the Iowa Conservation Commission with walleyes, northern pike and catfish, the program planned by the Corps for campers and visitors is year-round with "something for everyone."

During the summer of 1980 a new interpretive area in which to hold programs was completed in a remodeled garage at Red Rock. Among the programs sponsored by the Red Rock staff have been a fluorescent paint night hike, slide shows on the construction of the reservoir, a talk on local Indian artifacts, a natural foods tasting session, a session on natural dyeing, and guest speakers such as Sylvan Runkle, author of *Wildflowers of the Iowa Woodlands*. Annual events at Red Rock now include Eddyville Environmental Days and a Family Days Event. On May 1, 1980, the annual Marion County Sixth-Grader Days involved more than 500 children who visited five environmental stations manned by rangers, Iowa Conservation Commission members, soil conservationists, and knowledgeable local residents.

A few miles to the north, Saylorville Lake has been even busier, where camping has continued nearly year-round. Features at Saylorville include a bike trail, a cross country ski trail, and the Wauconsa Nature Trail used by the interpretive program. The number of recreational activities at Saylorville has necessitated a monthly newsletter of scheduled events which is sent out to a large mail-

ing list. Newspapers and radio and television stations announce upcoming events. As with Saylorville and Red Rock, Coralville, too, runs a full schedule of recreation activities.

Visitor Centers. Corps of Engineers installations in the Rock Island District have always welcomed visitors ranging from the merely curious to school children on educational tours, but since the later 1970's, most of the public probably first becomes acquainted with the activities of the Corps of Engineers through three visitor centers in the District.

The first of these centers to be completed was the Saylorville Lake Visitor Center facing Lake Saylorville on the east side of the dam, which opened on June 15, 1977, and was visited by more than 128,000 people in its first year of operation. The center at Saylorville is two levels, with the upper level housing exhibits and an office for the park manager, while the lower level houses storage space and offices for the assistant park manager and ranger staff assigned to Saylorville. The modern brick building with cathedral beamed ceilings and skylights, features slide shows covering the Corps recreation program, displays of artifacts found in the area and information on the purpose of the Corps of Engineers, aquariums stocked with fish found in Saylorville Lake, as well as reading and discussion areas. In 1978 the center was selected as an Award of Merit winner in the architecture category of the annual U.S. Army Chief of Engineers Design and Environmental Awards Program.

In March of 1978 the District began work on a $400,000 visitor center at Locks and Dam 15. The purpose of this center was to show the public how important Mississippi River navigation is, and to demonstrate what the Corps of Engineers has done to improve that navigation. The Locks and Dam 15 Visitor Center involved remodeling the existing lockhouse adjacent to the main lock into a two-story modern facility, with the exhibits section housed on the second story. The exhibit area not only explains the working of the locks, but gives visitors a first-hand view of the operation through a glass wall

which projects out on the lock side of the building. The exhibits are supplemented by a multi-screen slide show explaining the history of the Corps and its various activities, and by park rangers who are available during open hours to answer questions. The center officially opened on Armed Forces Day, May 17, 1980, and has been busy since then. River traffic is still a romantic aspect of American transportation to most people, and visitors are capable of spending hours just standing behind the glass wall or on the outdoor observation deck watching the quiet slow process of a towboat locking through.

With the transfer of the Illinois Waterway to the Rock Island District on July 1, 1980, a third visitor center became part of the Rock Island District's responsibilities. The Chicago District had completed a modern center adjacent to the lock at Starved Rock Lock and Dam near Utica, Illinois. This center gives visitors to the Corps facilities on the Illinois River an informational experience similar to the center at Rock Island, with audio-visual displays, an auditorium, and observation decks.

Regulatory Functions. Throughout the 19th century, navigation improvement remained the single-minded emphasis of the Rock Island District. Congress added flood control to the Corps' responsibility in the first half of the 20th century. By the second half of the 20th century, however, as our technological society grew more complex, Congress, and other groups responsible for the well-being of the nation's waterways, came to realize that natural resources must be used with care. Each new human activity produced increasingly complicated short- and long-term effects on the environment. As caretakers of water in the United States (a basic natural resource not as limitless as it once seemed), the Corps of Engineers, since the late 1960's, has taken a more and more active role in regulating the quality and use of that water.

Section 10 of the River and Harbor Act of March 3, 1899, gave the Corps of Engineers regulatory power to protect navigation channels on the nation's waterways from encroachment by private

or public parties. The purpose of this early regulation was simply to aid navigation, but in 1968, in a period of growing concern for the environment, Congress broadened these responsibilities to include not only navigation, but conservation, pollution, ecology, fish and wildlife, and aesthetics. The Corps regulatory function was expanded even further by passage of the Federal Water Pollution Control Act Amendments in 1972. This act established a permit program, administered by the Corps, to regulate the discharge of dredged or fill material into all navigable waterways.

An order by U.S. District Court for the District of Columbia on March 27, 1975, extended the Corps jurisdiction to all navigable waters of the United States and all contiguous or adjacent wetlands. On September 1, 1976, the Corps was directed again to expand its permit program to include primary tributaries of navigable waterways, natural lakes over five surface acres, and contiguous and adjacent wetlands. Finally on July 19, 1977, the Corps was given jurisdiction over virtually all waters of the United States: secondary, tertiary, and higher order streams which have a minimum flow of five cubic feet per second for at least 183 days each year.

Today, any activity subject to regulation by the Corps must obtain an individual, general, or Nationwide permit. Nationwide permits apply anywhere in the United States, permitting small noncontroversial activities with little government interference. General permits are processed and issued by individual Engineer Districts and are used for small projects that are clearly of little harm to the environment: small boat docks and bank protection projects. Individual permits are obtained from the Corps of Engineers through district offices for those major projects which need review by Federal, state, and local agencies, as well as a public interest review conducted by the Corps.

As a result of this regulatory function, the Corps processes an increasing number of permit applications each year. Between October 1, 1979, and September 30, 1980, the Rock Island District authorized 490 projects under the Nationwide permit.

Another 303 applications were filed under the general and individual permit categories; 259 of these were processed.

Environmental Concerns. As recently as the 1950's, worry about the effects of any activity on the quality of the environment did not receive a high priority from most organizations and individuals in the United States. This was true of the Corps of Engineers as well. Engineers on the Upper Mississippi River as early as Lieutenant Lee in 1837 considered what might be construed now as environmental concerns, and there is evidence that Colonel Mackenzie and others worried about destroying Indian artifacts during the quarrying of rock for wing dams; but to imagine that a major project could be halted because it might make extinct a small fish or plant would have seemed outrageous in 1900.

No longer. Today the Rock Island District not only evaluates permit applications from an environmental perspective, it also undertakes its own environmental studies to prepare environmental impact statements for its own projects, as required by the Federal Government for any proposed activity affecting the quality of the human environment. These environmental impact statements detail the impact an activity will have on that environment and serve as a tool for the decision makers. The Rock Island District now prepares statements for all new construction in the District, and has done so for projects such as the Clinton and Waterloo Flood Protection projects, already under construction.

One example of the wide range of the District's environmental investigations was the large scale mussel survey on the Upper Mississippi begun in 1977. The St. Paul and Rock Island Districts, responding to the concern of environmentalists over the effect of maintenance channel dredging on the many fresh water mussel species, several of which were rare and endangered, contracted the Philadelphia Academy of Sciences to determine the location, abundance, and ecological requirements of the endangered species. Fourteen sites in the Rock

Island District scheduled for future dredging were examined to insure that the impact of such dredging would be minimized.

For even longer than the Rock Island District has been regulating its own activities and those of others in order to minimize adverse effects on the environment, it has been actively engaged in maintaining and even increasing the quality of the land under its jurisdiction. These lands include those acquired for the 9-foot channel project, for the Illinois Waterway, and for the three Iowa reservoirs. Public parks and recreation areas are but two of the many uses to which the approximately 200,000 acres of land administered by the Rock Island District Real Estate Field Office are put. Land administered by the District is used for a wide range of activities from timber management to industrial use. Most of the land is leased or licensed to other organizations, generally other Federal, state, or local agencies. With few exceptions, nearly all of the leased land is used for purposes that enhance the Corps' recreation or environmental interests. The few hundred cottage sites along the Mississippi River still leased to private individuals are scheduled to be phased out by 1988.

The largest number of acres under this program are lands scattered in several of the pools in the Rock Island District section of the Mississippi River which are subject to periodic flooding. This 83,712 acres is used by the U.S. Fish and Wildlife Service in connection with the national migratory bird management program. Some of this land is farmed, but the crops grown on it are used for food for wildlife, after the farmer has taken his share.

In addition to the land along the Mississippi River, the Iowa Conservation Commission has been given charge of 25,452 acres of land at Red Rock Lake, 10,904 acres at Saylorville, and 13,048 acres at Coralville to use for wildlife conservation. Other lands at the three reservoirs are under agricultural lease, but in all these cases the lease details how the land should be used, including crop rotation and other conservation measures. At Red Rock, for example, four rows of crops on two sides of each field

must be left standing as food and shelter for wildlife. In cases where money is obtained from the rental or lease of such lands, ¾ of all the money received is turned over to the state to be spent for the public schools or roads in the county in which the project is located.

As a result of the land management program, then, a large proportion of Corps-owned land has been turned into wildlife refuges supervised by other agencies. In addition, the Corps has undertaken a number of wildlife programs itself on land it supervises. At Lake Red Rock, for example, forestry students from Iowa State University assisted Corps personnel in making a timber inventory of Corps lands and drawing up a forestry plan. In 1980, following this plan, reforestation was carried out through the planting of nearly 60,000 seedling trees. At the same time, local school children supervised by the Marion County Plant Iowa Committee began a Children's Forest on Corps land.

To further attract wildlife, Corps personnel planted several food plots and set out wood duck boxes and bluebird houses. Additional acres of land were planted with prairie grasses.

Elsewhere in the Rock Island District there were similar environmental activities. In December 1978 District personnel at each of the locks and dams began weekly surveys of bald eagles in the area, noting roosts, feeding areas, and other behavior which might document the eagles' movements and aid in protecting them as they wintered on the Upper Mississippi, feeding on fish from the ice-free water below each of the dams.

The Future of the Rock Island District

The Corps of Engineers will never reach that future day, as some people have imagined, when all navigation improvements have been made and all flood protection works erected. No one ever completely tames a river, and the Mississippi especially seems to have new tricks up its sleeve each year.

A continued increase in river traffic may well force Congress and the Engineers to make some future decision about improving the locks, although recent studies of year-round navigation and the possibilities of a 12-foot channel seem to have ruled those out. Provisions exist at each of the locks for an auxiliary lock similar to that at Lock 15. The auxiliary locks provide for the standard 110-foot width, but they could be built to the 1,200-foot length of Lock 19 at Keokuk, lessening the need for double locking. The advantage of this plan is that it could be carried out with minimal interference to navigation through the existing locks.

Flood control will remain a significant part of Rock Island District responsibilities for the foreseeable future. As the levee systems increase in number along the river, they will contain flood waters in an ever narrower area, and the flood waters, unable to spread out over their normal flood plains, will crest ever higher and higher, increasing, in turn, the need for additional flood protection and higher levees.

There are no new or dramatic flood control projects in the offing. Several reservoirs have been considered, in addition to those already constructed, but a rapidly increasing spread of population into once-rural areas makes it unlikely that there will be any future reservoirs. Flood control will likely proceed as in the past, by local projects.

As awareness of natural resources and our obligations to them grows, District involvement in environment and recreation will continue to take its place as a major Corps responsibility. Several other Engineer Districts in heavily industrial areas have already begun programs to enhance water quality through management and pollution control, and this new kind of "improvement" could well be part of the future Rock Island District.

Perhaps, after all, it is idle to speculate on what the second century has in store for the Rock Island District. Could Colonel James Wilson, when he arrived at Keokuk in 1866, ever have imagined the

present multi-million dollar organization or the modern Mississippi River? Perhaps there are not only dreams still unfulfilled, but dreams still undreamt.

Notes

Chapter 12

1. Interview with Colonel Nelson Leclair, Jr. (Ret.) May 14, 1973.

2. Widely reported in the Rock Island *Argus* and the Davenport *Times Democrat*, various issues, August 11, 1953, to February 9, 1954.

3. Various issues of the *Argus*, *Times Democrat*, and Moline *Dispatch*, September 25, 1957, to February 12, 1958.

4. Colonel Frederick Mueller, *Tower Topics*, Vol. 1, #10, February 1979, p. 2.

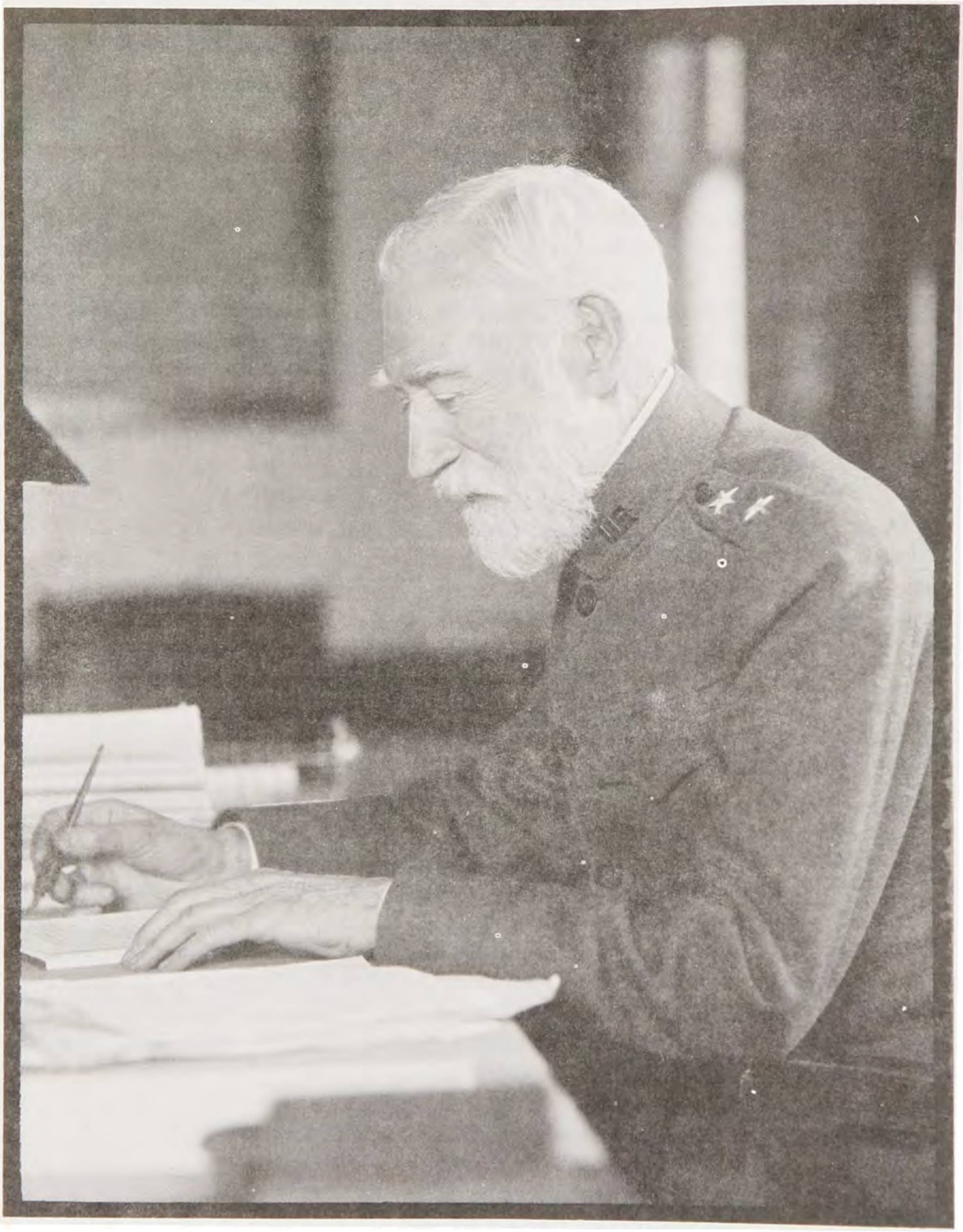
5. A complete account of Federal improvements on the Illinois Waterway can be found in John Larson, *Those Army Engineers, A History of the Chicago District U.S. Army Corps of Engineers* (Washington, D.C., GPO, 1980), pp. 211-232.

6. Interviews with Paul Danker, former Chief of Supply, June 24, 1973, and Willard Lappin, Head, Paint Lab, December 5, 1973.

7. John L. Rohwedder, informal typed and handwritten history of the Rock Island District Paint Lab, Rock Island District Historical Files.

8. "Hydropower Studies in the Rock Island District," typed copy, Rock Island Files, Section 8.

9. Various interviews with Robert Clevenstine, Frank Ashton, Ray Stearns, and Colonel Nelson Leclair, Jr.



Brigadier General Alexander Mackenzie, District Engineer at Rock Island for 16 years.

Afterword

The Men and Women Who Made It Happen

It may seem natural to end this history by adding up the total amount of appropriations spent by the Rock Island District since 1866, counting the linear feet of dams and levees constructed, and measuring the cubic yards of earth, rock, concrete, and brush used or dredged. Such figures would be impressive, considering the long and active history of the District.

But it seems more fitting to end by measuring the men and women who made it happen rather than by the machines they used. From the beginning of the improvement work personnel has been the strongest asset of the Rock Island District. The visions and the technical competence of these civilians and military engineers have done more to shape the Upper Mississippi River than all of the yearly politics and appropriations.

At first glance, the way in which an Engineer District is run seems to violate sound business principles. A normal tour of duty for a District Engineer is only three years. The officer who comes as a new District Engineer has often been at quite a different kind of duty, and naturally arrives unaware of many of the problems peculiar to a given District. Then almost as soon as he gets on top of things, he is transferred.

From the military standpoint, the purpose of this frequent transfer is to give the officer experience at as many kinds of installations and problems as possible. In this way civil works have provided peacetime training for wartime necessity.

There is another advantage. Because the Corps of Engineers' civil works usually involve contract

work, because the procedure for authorization of projects going, as it must, through Congress, often involves politics and special interest groups, and because nearly all improvement projects hurt some interests while helping others, it is essential to have someone in charge who has not had time to make either very close friends or bitter enemies among the population of a District. Contractors and others engaged in river work have come to respect this frequent change of command because they know they will be treated fairly.

Then, too, each of the District Engineers has added his own strengths and interests to the improvement work. Together, these different perspectives and emphases have enriched the understanding and broadened the base of the Corps' work on the Upper Mississippi. Two Rock Island District Engineers went on to become Chiefs of Engineers: Colonel Alexander Mackenzie and Major Raymond A. Wheeler.

At the same time, under this system where a change of top management occurs frequently, some other form of continuity is essential. There must be long-term employees on whom the District Engineer can rely for information about the District and its projects, employees with experience in the problems of the District. In this, the Rock Island District has been fortunate; it has been the rule rather than the exception for key employees to remain with the Corps for most of their careers. The number of employees who have put in 30 or 40 (and even more) years with the District would be the envy of any private industry. These men and women, with their gradually accumulated knowledge, have provided the steady development of improvement work which has characterized the Rock Island District. Such "river rats" have given the District a continuity and direction it could not otherwise have had.

A long list of civilian engineers and other employees who have made outstanding contributions during their careers might be made. L. L. Wheeler, James H. Grove, John Peil, among many retired employees, deserve mention. So do those who came in

the early 1930's to work on the 9-foot channel, and who formed a team that provided leadership in that project, as well as in military construction during World War II and in the gradual shift to flood control works in the years since 1950. Appendix B, notes the chiefs of the engineering division, those employees who have been the principal civilian in charge under the District Engineer, and those civilian employees selected by an employee committee to be honored as Distinguished Civilian Employees.

Two civil engineers, however, deserve special mention because they gave so much shape and direction to the early work of the District during its formative years. The most legendary of these men was Montgomery Meigs, who served the District for 52 years, from 1874 to 1926.

Meigs was the son of Lieutenant Montgomery Meigs, who assisted Lieutenant Lee on the rapids in 1837, and who went on to become Quartermaster General of the Union Army. The younger Meigs was born in Detroit, Michigan, on February 28, 1847. He received his engineering degrees from Harvard University and the Royal Polytechnic School of Stuttgart, Germany.

When Meigs joined the Rock Island District in 1874 his first task was a comprehensive survey of the Mississippi from St. Paul to La Crosse, the survey from which Meigs and C. W. Durham developed the plan for wing dams for the 4½-foot channel.

In 1876 Colonel Macomb requested that Meigs be appointed a United States Civil Engineer. This post had been established by Congressional resolution in 1867 in order to supplement the number of military engineers engaged in Western rivers improvement work. Of the five such appointments authorized by Congress, three were in the Rock Island District. The first was D. C. Jenne, in charge of the Des Moines Rapids in 1867; the second was H. C. Long, in charge of snag and dredge boats in 1871; and the third was Meigs in 1876.

Beginning in 1881 when charge of the Des Moines Rapids Canal was returned to the Rock Island District, Meigs supervised its operation, and was also in charge of the Mississippi from Burlington to Hannibal. In this capacity, he supervised wing dam construction, dredging, and harbor and levee improvements.

His first love, however, was boats. He supervised construction of the dry docks at Keokuk, where he built 14 steamboats and dredges for the Rock Island District. In addition, he designed four other steamboats built by contractors. The coming of the gasoline launch was Meigs' nemesis. He was an inveterate tinkerer, always trying something new, always looking for new economies. His gas launches contained quantities of improvised parts and the cheapest engines available, and they never did work well or long.

Meigs had a number of other interests, including photography and model building. He was responsible for many of the pictures of early Corps' projects, and he built many models of the improvements. He made models of boats, rafts, wing dams, before-and-after-improvement river dioramas, and his own inventions for the 1893 World's Fair, for the 1903 Louisiana Purchase Exposition, and for the museum of the West Point Academy.

In 1898 Meigs proposed a method of improving county roads by oiling them, an idea that was adopted throughout the United States. He retired from the Corps of Engineers in 1926 at the age of 79, and died on December 9, 1931, in Keokuk.

Although not so widely known today, one of Meigs' contemporaries, C. W. Durham, was also instrumental in shaping the improvement work of the District during the last quarter of the 19th century. Durham arrived to become an assistant engineer in the Rock Island District in 1871, three years before Meigs. In 1873 Durham supervised construction of the first experimental wing dam near Pig's Eye Island. He subsequently worked closely with Meigs in developing the wing dam plan.

Durham held a variety of duties with the Corps during his 49 years with the District. He became Principal Assistant Engineer at the Rock Island Office. From here for many years he supervised the snagboat service and was in charge of all bridge matters in the District. He spent several seasons from 1876 to 1881 as captain of the *Montana* and the *General Barnard.*

As part of his work in the office, Durham wrote a good portion of each of the Rock Island sections for the *Annual Reports.* In the course of this, he wrote detailed accounts of the history of the rapids improvement, the Rock Island District fleet, and complete specifications for every wing dam built in the District.

In addition, Durham actually made many of the engineering decisions in the Engineer Office until about 1912. A succession of District Engineers, coming in green, relied on Durham's knowledge and expertise in river matters for their orientation to the District. Durham also wrote much of the official District correspondence. On at least two occasions when the District was between officers, Durham handled all duties normally handled by the District Engineer. In 1917, in fact, during the tenure of Major Wildurr Wilding, Durham handled everything; there is no sign in official records that Major Wilding ever arrived in Rock Island.

C. W. Durham, fortunately, was a collector of facts, figures, and records. Now and then he went too far. On September 14, 1912, Major Keller, unable to find his copy of the last river and harbor bill, wrote a note to Durham: "I have repeatedly asked you not to confiscate, secrete, or remove from the files any of our records."[1] However, this collecting instinct was responsible for the preservation of those records the Rock Island District still has. The *Annual Reports* from 1867 to 1900 in the District files are all Durham's private copies from his office.

Durham suffered increasingly long periods of illness from 1915 on, though he continued to work when he could, until he retired in 1920.

the shape of the river along nearly every mile, replacing the old Mississippi across which Sunday excursionists used to walk during low water with slack water pools, covering the bottom lands and creating countless willow islands where swamps had been. There was also the matter of money. The Rock Island District spent nearly as much money each year on the 9-foot channel as they had spent altogether on the 4½-foot channel.

Another significant difference between this and previous projects was the coordinated planning it involved. The 4½-foot channel project never developed a comprehensive plan. District personnel took so seriously the role of the Corps as "servant of the people" that they habitually waited for Congressional appropriations and directions to plan for the coming year.

The result had been a lack of uniformity in both planning and in results. Major Riche complained in 1910 that in the two districts in his charge (he was still District Engineer of the Second Chicago District), there were 40 locks in five different sizes. These varied from the small 170-foot by 35-foot locks of the Illinois and Mississippi Canal to the Moline Lock at 350 by 80 feet. This lack of uniformity continued when a Board of Engineers fixed the new power company lock at Keokuk at 358 by 90 feet, and when Congress authorized the Le Claire Canal with a 350- by 80-foot lock. In contrast, the new 9-foot channel project produced locks identical in almost every respect.

The 9-Foot Channel Project

The decade of the 1930's was the most exciting period the Rock Island District had ever experienced as it rose to the demands of the 9-foot channel project. The interest generated by the project in towns along the river, the scope of the work, the challenge of something so different from and larger than previous projects, and the Great Depression itself all served to generate a feeling of teamwork that

would be the envy of most other multi-million-dollar corporations.[6] The 9-foot channel boosted local economies and provided jobs for hundreds of professionals and skilled workers as well as for thousands of laborers. Many employees who came to work on the locks and dams in the 1930's remained with the District and kept up the spirit of teamwork long after the project was completed. During the past few years they have nearly all retired.

For both employees and area residents, the symbol of this change from old to new was the move of the Rock Island District Office in 1934 from the overcrowded quarters in the Federal Building where it occupied the second and third floors above the post office, to its own building on Arsenal Island. Storehouse A, popularly known in the area as the Clock Tower Building, was the first building constructed for the Rock Island Arsenal in 1864. Abandoned almost immediately as the remainder of the Arsenal located further eastward on the island, the Clock Tower Building adjacent to the first of the locks and dams planned for the 9-foot channel, made an ideal location for the District. The building quickly came to stand for the District in the minds of area residents.[7]

When the District Office moved into the Clock Tower Building, personnel found themselves with a clear view of the new Locks and Dam 15, begun in 1931 and now virtually complete. Much work already lay behind this new construction.

The first task of the Engineers on the 9-foot channel project was to establish a large real estate and lands section. Because of alterations of the shoreline caused by pooling the water and thus raising the water level, virtually every square foot of both sides of the Mississippi had to be surveyed.

Both natural conditions and population concentrations along the river determined the design, location and number of dams in the project. The low banks of the Upper Mississippi in front of a heavily cultivated flood plain, and the close encroachment of railroad tracks and towns precluded the construction of a few high dams. This meant that the dams

gaining most attention for a trestle bridge over the Little Tennessee River built in 32 hours from dismantled houses.

Wilson was promoted to brevet major general, U.S. Volunteers, in 1864 for gallant and meritorious service. On May 10, 1865, a detachment of his forces captured Jefferson Davis, the Confederate President.

On July 28, 1866, Wilson was appointed a lieutenant colonel in the 35th Infantry, and three days later was assigned to be superintending engineer of the survey of the Rock and Illinois Rivers. On August 3, he was further ordered to superintend the improvement of the Des Moines and Rock Island Rapids in the Mississippi River. He remained at this post until his retirement from the Corps of Engineers on December 31, 1870.

Wilson's appointment to the Rock Island District marked the beginning of continuous activity by the Corps of Engineers on the Upper Mississippi. Under his leadership the first substantial surveys of the two rapids and the Rock and Illinois Rivers were undertaken, and the first permanent improvements of the Des Moines and Rock Island Rapids were planned and begun. His most notable achievement was the design of the Des Moines Rapids Canal around the Des Moines Rapids.

Wilson maintained a life-long interest in writing, publishing several volumes of biography and memoirs. His first book, *The Life of Ulysses S. Grant,* written together with Charles H. Dana, was published while he was District Engineer at Rock Island in 1868.

Following his resignation from the Army in 1870, Wilson became vice president of the St. Louis and Southeastern Railroad from 1871 to 1876. In 1876 he became chief engineer for the Gilbert Elevated Railroad in New York City.

During the Spanish American War, Wilson volunteered for service with the China Relief Expedition.

In the fall of 1900 he commanded American troops in the city of Peking, and in 1902 he represented the United States Army at the coronation of King Edward VII.

Between 1900 and 1908 he found time to author several biographies of prominent Americans. He was promoted to brigadier general in 1901 and to major general on the retired list in 1915. General Wilson died in Delaware at the age of 87 on February 23, 1925.

Colonel John N. Macomb

John Navarre Macomb was born in New York in 1811. He was commissioned brevet second lieutenant in the 4th Infantry on graduating from the United States Military Academy in 1832. During that year he served in the Black Hawk Expedition. In 1838 he was promoted to 1st lieutenant, Corps of Topographical Engineers.

Prior to the Civil War, Macomb was on topographical duty at Fort Trumbell (1832-34), was involved in the survey of the Detroit River (1840-42), and served as assistant engineer for the Survey of Northwestern Lakes (1842-51). From 1851-56 he was in charge of that survey, following which he was appointed Chief Topographical Engineer in the Department of New Mexico. In 1860-61 he served as Lighthouse Engineer of the 5th District.

When the Civil War began Macomb became Chief Topographical Engineer in the Army of the Potomac under Major General McClellan. In this capacity he was not only charged with surveys and reconnaissance, but with the responsibility of the new Balloon Corps. In 1861 and 1862, he developed methods of inflating reconnaissance balloons in the field using three large wooden tanks for each balloon, along with barrels of iron filings used to

generate gas for the balloons. Under his supervision, balloons were used as far west as Cairo, Illinois.

In 1863 Macomb was made superintending engineer of the construction of fortifications at Portsmouth Harbor, New Hampshire.

After the war Macomb was appointed Superintending Engineer of the Improvement of the Western Rivers. He was promoted to colonel, Corps of Engineers, in 1867, and on May 31, 1870, was given charge of several improvement projects on the Upper Mississippi River, including construction of the Rock Island Bridge and surveys of the Fox, Wisconsin and Minnesota Rivers. On October 1, 1870, he was placed in charge of improvement of the Rock Island and Des Moines Rapids, relieving Colonel Wilson of these duties.

As District Engineer at Rock Island, Macomb broadened the scope of the improvement work. In addition to continuing Wilson's projects on the two rapids and on the Illinois River, he initiated surveys of other treacherous sections of the Mississippi, and experimented with dredging and wing dam construction.

Macomb remained as District Engineer until November 15, 1877, when he was put in charge of Defense and Harbor Improvements in Delaware Bay. He remained at this post until his retirement on June 30, 1882. He died in Washington, D.C., on March 16, 1889, at the age of 78.

Major Francis U. Farquhar

Francis Ulric Farquhar was born in Pennsylvania in 1842. He graduated second in his class from the United States Military Academy in 1861 and was commissioned second lieutenant in the Corps of Engineers. He served with the Corps in various positions during the Civil War: drilling volunteers, as Aide-de-Camp to Colonel Heintzelman in the Manassas Campaign in 1861, and at the Battle of Bull Run. In 1863 Major Farquhar served as Chief Engineer of the Department of Virginia and North Carolina, and from 1864 to 1865 was Assistant Professor of Engineering at West Point.

Prior to his appointment as Rock Island District Engineer, Farquhar worked on harbor improvements in Lake Erie (1866-67), as Assistant Engineer for the Survey of the Northern Lakes (1867-68), and as Superintending Engineer of Harbor Improvements on the eastern shore of Lake Michigan (1868-72). Following his promotion to major in the Corps of Engineers in 1872, he served as Chief Astronomer of the Survey of the 49th Parallel of Latitude to fix the Northern Boundary of the United States (1872-73).

He became Superintending Engineer of Surveys and Harbor Improvements in the Upper Mississippi Valley and the West End of Lake Superior in 1873. In this capacity he had charge of projects in what is now the St. Paul District.

In November 1877 Farquhar was assigned to relieve Macomb of projects in his charge in the Rock Island District. He served in this capacity until June 30, 1879. During these years Farquhar laid the groundwork for the 4½-foot channel project, surveying, mapping, and experimenting with improved boats and machinery.

Major Farquhar died in Detroit on July 3, 1887, at the age of 45.

Brigadier General Alexander Mackenzie

Alexander Mackenzie was born in Potosi, Wisconsin, on May 25, 1844. He graduated from the United States Military Academy in 1864 and was commissioned second lieutenant in the Corps of Engineers. His tours of duty included Assistant Engineer, Department of Arkansas (1864-65), examination of levees of the Lower Mississippi (1865-66), and, following promotion to captain in 1867, Improvement of Harbors of Lake Michigan (to 1879).

On June 30, 1879, Captain Mackenzie replaced Major Farquhar as District Engineer at Rock Island. He served in this capacity for 16 years, longer than any other Rock Island District Engineer. During his tenure in office he supervised completion of the Des Moines and Rock Island projects, saw the 4½-foot channel well under way, and developed standardized plans and methods of improving the Mississippi River. He was promoted to lieutenant colonel in February 1895 near the end of his tour at Rock Island.

Mackenzie was among the best liked District Engineers. His colleagues found him "kind, patient, congenial."

In 1895 Mackenzie became a member of the Lighthouse Board, and in 1902 a member of the Board of Engineers for Rivers and Harbors. He was promoted to colonel in 1901, and in 1904 he was promoted to brigadier general and Chief of Engineers, a post he served until his retirement in 1908.

Mackenzie came out of retirement in 1917 in response to a World War I shortage of military personnel. He returned to the Rock Island District as District Engineer and Division Engineer of the Northwest Division until June 1, 1919. General Mackenzie died in Washington, D.C., on February 23, 1921, at the age of 76.

Lieutenant Colonel William R. King

William Rice King was born in New York in 1840. He graduated from the United States Military Academy in 1863, was commissioned a second lieutenant in the Corps of Engineers, and assigned as Assistant Engineer in the Department of North Carolina and Virginia from 1863-65.

He was promoted to captain in 1865 and assigned as Assistant Engineer with the Bureau of Washington, D.C. Between 1886 and 1895 he was in charge of construction at Fort Schuyler, New York. He was promoted to lieutenant colonel in 1888.

Colonel King served as District Engineer at Rock Island from July 6, 1895, until May 1898. During these three years his health was precarious, and much of the office work and correspondence was taken over by civilian assistants. He died at Rock Island on May 18, 1898.

In addition to his varied military duties, King engaged in a number of civil projects. He was the projector and constructor of an inclined cable road to the summit of Lookout Mountain, Tennessee, in 1885-86, and served as president of the company operating the road in 1886-87. He authored several technical works, including *Experimental Firing with Modern Seacoast Artillery* (1868), *Armor Plating for Land Defenses* (1870), and *Counterpoise Gun Carriage* (1869).

Colonel Curtis McD. Townsend

Curtis McDonald Townsend was born in Brooklyn, New York, on March 22, 1856. He graduated from the College of the City of New York in 1875 with a B.A. at the age of 19. On the advice of a friend he entered a competitive examination and received an appointment to the United States Military Academy. He was graduated in 1879, 4th in his class, and commissioned a second lieutenant in the Corps of Engineers.

His first assignment was to Willets Point, New York, where he served until 1882, when he was promoted to first lieutenant. He served as Assistant Engineer at Baltimore, Maryland, and Petersburg, Virginia. In 1886 Townsend became Assistant to the Engineer Commissioner in the District of Columbia. He returned to Willets Point in 1887 as Quartermaster of the Engineer Battalion in charge of building construction. In 1890 he was promoted to captain and assigned to duty in Washington, D.C., in connection with the construction of the Washington Aqueduct.

In 1896 Townsend was placed in charge of the Third Mississippi River District at Memphis, Tennessee. He was transferred to Grand Rapids, Michigan, in May 1898, and upon the death of Colonel King, was transferred to Rock Island as District Engineer.

Townsend served at Rock Island from 1898 until March 31, 1903. During this time the 4½-foot channel project was virtually completed. He published many articles dealing with engineering problems on the Upper Mississippi and encouraged his civilian engineers to do likewise. Much of the preservation of these early records in print today is due to the encouragement of Townsend.

In 1903 Townsend was assigned to the 3d Engineer Battalion in the Philippine Islands, where he served on the staff of the Chief Engineer, Philippine Division. During this time he was promoted to major. He supervised construction of military roads, building the Manila Breakwater and wharves for the city.

Townsend returned to Washington, D.C., in 1906 as a member of the Board of Engineers for Rivers and Harbors. He then served tours of duty at Cleveland, Ohio, and Detroit, Michigan. In 1912, having been promoted to colonel, he became Division Engineer of the Western Division at St. Louis, also serving as president of the Mississippi River Commission and as a member of the Experimental Towboat Board.

During World War I Townsend served in France. He retired in 1920, but was recalled from 1924-26 as District Engineer of the New Orleans District. Following World War I, Colonel Townsend wrote a basic college textbook, *Hydraulic Principles Governing River and Harbor Construction*, and published many articles in engineering journals.

Colonel Townsend died in Ithaca, New York, on May 26, 1941, at the age of 85.

Colonel James L. Lusk

James Loring Lusk was born in Pennsylvania in 1855. Following graduation from the United States Military Academy in 1878 and a commission as second lieutenant in the Corps of Engineers, he served as Assistant Instructor of Practical Military Engineering and of Natural and Experimental Philosophy at West Point. He remained at the Academy in the Departments of Tactics and Mathematics until 1881. In 1881 he was promoted to first lieutenant and served as an assistant to Major Danrell at the Academy until 1883.

In 1886 Lusk became Secretary and Assistant of the Construction Committee of the Mississippi River Commission. He was promoted to captain in 1888 and became Assistant to the Engineer Commissioner of the District of Columbia. In 1893 he returned to the Military Academy as Instructor of Practical Military Engineering, a position he held

until the Spanish-American War. He was promoted to major in 1898 and given command of Company E, Battalion of Engineers, 5th Army Corps. In May of 1898 he was promoted to lieutenant colonel and Chief Engineer, U.S. Volunteers.

In the fall of 1898 Lusk was made Assistant to the Chief of Engineers in Washington, D.C. On March 31, 1903, he replaced Colonel Townsend as District Engineer at Rock Island. During his tour as District Engineer, he supervised preparations for the coming 6-foot channel project, including preliminary plans for the Moline Lock on the Rock Island Rapids, and the Keokuk and Hamilton Water Power Company Dam at the foot of the Des Moines Rapids. On April 26, 1906, Colonel Lusk was transferred to the Survey of North and Northwestern Lakes. He died at Sandy Hook, New Jersey, on September 26, 1906, at the age of 51.

Colonel Charles S. Riche

Charles Swift Riche was born in Philadelphia, Pennsylvania, on July 19, 1864. He was graduated third in his class from the United States Military Academy in 1886. Following a commission as second lieutenant in the Corps of Engineers, he was ordered to Willets Point, New York, where he served with the U.S. Battalion of Engineers and attended the Engineer School of Application, from which he graduated in 1889.

From 1889 to 1895, Riche was on duty at Detroit, Michigan, and Sault Ste. Marie, Michigan, as Assistant Engineer on the Survey of the North and Northwestern Lakes. He assisted in the design of the Poe Lock at Sault Ste. Marie. Between 1895 and 1903 he saw duty at Willets Point; at the 4th District of Lower Mississippi River Improvement; as Assistant to the District Engineer at Galveston, Texas; then District Engineer at Galveston, where

he supervised construction of the Galveston Jetties and built many of the fortifications of Galveston Harbor; and as Chief Engineer Officer, Department of Texas. He was promoted to captain in 1898.

In 1903 Riche was placed in charge of the Second Chicago District covering the improvement of the Illinois River and the Illinois and Mississippi Canal construction. In 1904 he was promoted to major.

He became District Engineer at Rock Island on April 1, 1905, while retaining charge of the Second Chicago District. In addition to supervising construction of the Illinois and Mississippi Canal, Riche supervised the design, planning, and construction of the Moline Lock and initiated work on the 6-foot channel project after preliminary surveys were authorized in 1905.

On March 15, 1910, Riche was transferred to Detroit, Michigan, in charge of the Coast Survey of the Lakes and of the Harbors of the East Shore of Lake Michigan. He remained at this post until 1912, when he resumed his post at Galveston, Texas, in charge of the Galveston Engineering District. He remained at Galveston until 1916 when he returned to Chicago, following promotion to colonel.

From 1918 to 1921 Riche was in Panama as Chief Engineering Officer, construction fortifications. He retired in 1921 after 35 years of service. Following his retirement he was engaged in consulting engineering work in various parts of the country, based at St. Louis. His most notable civil work was as a member of the Chicago Sanitary District Engineering Board of Review.

On March 20, 1926, Colonel Riche died in Houston, Texas, at the age of 61.

Colonel Charles Keller

Charles Keller was born in New York on February 13, 1868. He graduated second in his class from the United States Military Academy in 1890 and was commissioned a second lieutenant in 1892.

He was promoted to first lieutenant in 1895, to captain in 1900 and to major in 1907. Prior to coming to Rock Island, Keller's tours of duty included Improvement of Lake Michigan at Grand Rapids (1901-03), the Philippines (1903-05), and charge of the Survey of North and Northwestern Lakes from 1905 to 1910.

Keller served as Rock Island District Engineer from March 15, 1910, until October 16, 1913. While this was a frustrating period for river interests, with a rapid decline of long-haul freight and passenger service on the Upper Mississippi, it was a period marked by rapid growth for the District as it prepared to spend $2,000,000 a year on the 6-foot channel project. In 1911, the Illinois and Mississippi Canal operations and maintenance were transferred to the Rock Island District. The Keokuk and Hamilton Water Power Company began construction of their power dam and lock just after Keller arrived and completed it just two months before he left. While District Engineer at Rock Island, Keller was also a member of the Experimental Towboat Board.

Following his tour of duty at Rock Island, he served on the War Industries Board in 1917-18, and at the Office of the Engineer Commissioner at Washington, D.C. He retired in 1923 and joined the Byelesby Engineering and Management Corporation in Chicago, where he was responsible for construction of the El Dorado power project near Placerville, California.

Colonel Keller died in California on September 16, 1949, at the age of 81.

Brigadier General George M. Hoffman

George Matthias Hoffman was born in Wilkes-Barre, Pennsylvania, on June 15, 1870. He graduated second in his class from the United States Military Academy, received a commission as second lieutenant, and was assigned to River and Harbor duty at New Orleans.

The outbreak of the Spanish-American War interrupted his course at the Engineer School at Willets Point, New York. In Cuba he served in the field with the Engineer Battalion during the Santiago Campaign, then returned to the Engineer School for a second tour. He was promoted to first lieutenant in 1898. For the next three years he was on engineering duty in Washington, D.C., working on the Washington Aqueduct water supply tunnel and on filtration plants. He then served as Assistant Instructor at the General Service and Staff College, Fort Leavenworth, Kansas, and on River and Harbor work at Galveston, Texas, and Vicksburg, Mississippi.

In 1904, he was promoted to captain and appointed as Assistant Division Engineer, Isthmanian Canal Commission, and Resident Engineer, Panama Canal Zone. The difficult and crucial task of constructing the Gatun Dam was under his charge.

After nearly six years in the Canal Zone, Hoffman was ordered to duty as District Engineer at Rock Island, replacing Major Keller on October 16, 1913. He served in this capacity until April 30, 1917. Most of the work in the District during his tenure consisted of continued development of the 6-foot channel project, of which the largest single item was construction of the Le Claire Canal at the head of the Rock Island Rapids. During this time the Rock Island District fleet, already large, grew to be the largest fleet of any Engineer District in the United States, numbering nearly 200 named boats.

World War I brought most civil works in the District to a halt. On April 30, 1917, Hoffman was transferred to Fort Benjamin Harrison, Indiana, as Senior Engineer Instructor at the Officers Training

Camp. In July he was ordered to France as Assistant Chief of the American Expeditionary Force, but within a few weeks he was placed in command of the Eleventh Engineers, an important railway regiment attached to the British Army on the Somme. In January 1918, he was appointed Chief Engineer of the First Corps, with which he saw action in the offensives of Chateau-Thierry, St. Mihiel, and Meuse-Argonne. For his ability in these campaigns, he was awarded the Distinguished Service Medal. In 1919 he was promoted to colonel.

Following the war, he became District Engineer at Louisville for one year. He graduated from the Army War College in 1921 and was placed on the General Staff Corps Eligible List. The following year he was sent to New Orleans to become Division Engineer of the Gulf Division and a member of the Mississippi River Commission.

He then briefly returned to troop duty in 1926, then took over duties as District Engineer of the First New York District, and, in 1931, became Division Engineer of the North Atlantic Division.

General Hoffman retired from active duty in 1934 with the rank of brigadier general, and died on November 1, 1936, in Montclair, New Jersey, at the age of 66. He was buried in Arlington National Cemetery.

Lieutenant Colonel Wildurr Willing

Wildurr Willing was born on May 1, 1876. He graduated from the United States Military Academy in 1901 and was commissioned second lieutenant in the Artillery. In 1902 he transferred to the Corps of Engineers.

From 1902 to 1905, Willing was Instructor of Engineering at the United States Infantry and Cavalry School. He was promoted to first lieutenant in 1904, and in 1905 was assigned to the Insular

Government, Panama, as Assistant Lighthouse Engineer. He was promoted to Lighthouse Engineer in 1907. In 1908 he returned to the States to river and harbor work at New Orleans.

Willing was appointed District Engineer at Rock Island on April 30, 1917, to replace Major Hoffman, who had been transferred because of the war effort. He served in this capacity less than two weeks, until May 12, 1917, when General Alexander Mackenzie came out of retirement to return to Rock Island.

Not only was Willing's tenure as District Engineer the shortest in the Rock Island District, there is no evidence in the District files or elsewhere that he ever actually arrived in Rock Island. All correspondence was carried on by civilian employees. His appointment as District Engineer became one of the casualties of hurried wartime planning.

Willing was promoted to colonel in 1917, was returned to the grade of major following World War I, and was promoted to lieutenant colonel in 1920. Following the war, Colonel Willing served as District Engineer at Boston, Massachusetts; as Department Engineer, Panama Canal Zone; as Division Engineer, Panama Canal Division (1927-28), and as District Engineer at St. Paul from 1929 to 1933. He died in New York City on November 19, 1958.

Brigadier General Harry Burgess

Harry Burgess was born in Starkville, Mississippi, on February 22, 1872. He attended the Agricultural and Mechanical College of Mississippi for three years before entering the United States Military Academy in 1891. He graduated second in his class in 1895, and was commissioned a second lieutenant, Corps of Engineers.

Following graduation, Burgess served tours of duty as Assistant to the District Engineer at

Savannah, Georgia; and as assistant in the development of the Mobile, Alabama, Harbor. After attending the Engineer School of Application at Willets Point, he engaged in submarine mine defense of the harbors of Galveston and New Orleans.

In 1900 Burgess was assigned as Instructor of Engineering at the United States Military Academy, but after serving only a few months, he left to join the Engineer Battalion in the operations of the Philippine Insurrection.

From 1903 to the beginning of World War I, he served as District Engineer in charge of works at Louisville, Kentucky; New Orleans, Louisiana; Nashville, Tennessee; and Detroit, Michigan. In 1917 he organized the 16th Engineer Railway Regiment at Detroit, commanded it and took it to France. In France, he was Corps Engineer and Commander of the 305th Engineers.

Burgess received regular promotions during this time: to first lieutenant in 1898, to captain in 1904, to major in 1909, to lieutenant colonel in 1917, and to colonel in 1920. He arrived in Rock Island to become District Engineer on June 1, 1919. The War had interrupted most projects in the District, and it became Burgess' responsibility to get them moving again. Construction began on the Le Claire Lock and work resumed on the dredging, wing dams, and other projects on the 6-foot channel.

He left the District on June 16, 1922, to become Commandant of the United States Engineer School at Fort Humphreys, Virginia. In 1924 he became Engineer of Maintenance of the Panama Canal, and in 1928, Governor of the Panama Canal Zone. Upon retirement in 1932 when his tour of duty as Governor was completed, he was made a Brigadier General of the Line of the Army. General Burgess died at the Army Hospital in Hot Springs, Arkansas, on March 19, 1933.

Brigadier General Beverly C. Dunn

Beverly Charles Dunn was born in Virginia on June 16, 1888. He graduated from the United States Military Academy in 1910 and was commissioned second lieutenant, Corps of Engineers.

Prior to coming to Rock Island, Dunn served as an instructor at the Army Industrial College and was engaged in River and Harbor work in New York. He was promoted to captain in 1919 and major in 1920.

Dunn became District Engineer at Rock Island on June 16, 1922. During his five years in this office, the work of the District grew increasingly complex. The long decline in river traffic reversed as the 6-foot channel neared completion, and the District broadened its responsibilities to include flood protection work on levees south of Rock Island. The Le Claire Canal and Lock was completed and opened to traffic. Dunn remained as District Engineer until August 15, 1927.

During World War II Dunn served as Deputy and then Chief Engineer with the Supreme Headquarters Allied Expeditionary Forces under General Eisenhower in Europe. He retired with the rank of brigadier general in 1948, after 38 years of service with the Army.

Following retirement he served with the Association of American Railways and became chairman of the board of James King and Company, a large firm of general contractors in New York City. General Dunn died on August 21, 1970, in New York.

With new Lock 19 nearing completion in the spring of 1957, Rock Island District officials planned a ribbon-cutting ceremony to celebrate the opening scheduled for the second week of May. However, on May 1, while the Stage II contractor was testing the operation of the new lock prior to turning it over to the Corps of Engineers, a tow coming upstream waiting to go through old Lock 19 encountered cross currents caused by the testing and requested permission to come through the new lock. The contractor received permission from the Rock Island District to do so, and so the *Hawkeye* with 12 barges of coal became the first boat through the lock. The first locking-through took one hour; at the old lock the same tow would have required five hours.

Two weeks later, on Tuesday, May 14, the Rock Island District formally opened new Lock 19. When the lock opened at 8 a.m., the *Lachlan Macleay* of the Federal Barge Lines entered the lock, greeted by only a handful of District employees. The tow of seven barges of steel, sulphur, and coal locked through in one-half hour.

Formal dedication ceremonies for Lock 19 were held on August 19, 1957. In addition to Rock Island District personnel, speakers at the dedication included Assistant Secretary of the Army Dewey Short, Chief of Engineers Major General Emerson C. Itschner, and Iowa Governor Herschel Loveless. The official dedication at 3:00 p.m. followed a luncheon, open house, and parade.

Lock 19 was completed at a cost of $13,500,000, somewhat more than the 1930 estimate of $1,500,000. It still remains the largest and most impressive lock on the Upper Mississippi. It furnishes a usable lock chamber 110 feet wide by 1,200 feet long. Depth over the upper sill is 15 feet, with 13 feet over the lower sill. The maximum lift at low water stage is 38.2 feet.

All three lock gates are of steel construction. The downstream gate is a miter type, while both the upper service gate and the guard gate are submersible

vertical lift gates. In addition to protecting the service gate against damage from tows and ice flows, the guard gate serves as a roadway for vehicle access to the old lock and power dam.

As with all other locks in the Rock Island District, Lock 19 is filled and emptied by gravity. Intake and discharge valves control the water, which enters through intakes in the upper sill and is distributed to the lock through lockwall culverts. These in turn distribute the water to lateral culverts under the lock floor. The same system is used to discharge the water at the downstream end of the lock. The filling and emptying system fills the lock chamber in approximately ten minutes and empties it in about nine minutes. Just over 3,800,000 gallons of water are used for each emptying or filling.

Effects of the 9-Foot Channel. The 9-foot channel began to make a difference on the Upper Mississippi even before it was finished. The Upper Mississippi Wildlife and Fish Refuge Act passed in 1924 authorized the Biological Survey to buy overflow lands along the Upper Mississippi River. Conservationists at first felt that the 9-foot channel would ruin the potential of the valley for a wildlife refuge.

However, as the first pools were filled, the cooperative planning between the Engineers and the conservationists began to show results. In 1937 Ira Gabrielson, Director of the Fish and Wildlife Service, wrote an article in *Scientific American* in which he concluded that the dams were having a positive effect:

> A fine example of how large dams may help the wildlife resources is developing now on the Upper Mississippi River Wildlife Refuge near Winona, Minnesota. Two of the pools created here by the flood control and navigation dams have relatively stabilized water levels. These dams, which might easily have been so designed as to destroy most of the wildlife value of this great area are actually increasing these values. In the shallow portions of these stabilized pools, which lie outside the navigation channel, water plants, both the submerged acquatic and the emergent vegetation favorable to waterfowl and other marsh-loving birds, are establishing themselves in abundance.[15]

In a later book, Gabrielson pointed out that no single conservation organization could have benefitted wildlife so much as the Army Engineers had in

Lieutenant General Raymond A. Wheeler

Raymond Albert Wheeler was born in Peoria, Illinois, on July 31, 1885. He graduated from the United States Military Academy in 1911, fifth in his class.

Prior to coming to Rock Island, Wheeler participated in the Vera Cruz Expedition; served as commander of the 4th Regiment of Engineers in Germany during World War I; became District Engineer of the Newport, Rhode Island, District in 1919; and served as Assistant to the Engineer of Maintenance of the Panama Canal Zone from 1927 to 1930. From 1930 to 1933, Wheeler was District Engineer at Wilmington, North Carolina.

Wheeler became District Engineer at Rock Island on September 22, 1933, and remained until October 3, 1935. Under his direction, most of the locks and dams in the District were begun. In 1934 he supervised the transfer of the District offices from downtown Rock Island to the more expansive quarters in the Clock Tower Building on Arsenal Island. During his tenure as District Engineer, he directed the expenditure of more funds than had been spent by the Rock Island District in its entire previous history.

In 1935 Wheeler was made Chief Regional Engineer for the Works Progress Administration. In 1940 he was assigned to the Panama Canal as Engineer of Maintenance, where he remained until 1941, when he was assigned to the Persian Gulf Command. In 1942 he became Commanding General of Army Services of Supply Forces on the China-Burma-India Theater. He became Deputy Commander of Supreme Allied Forces in Southeast Asia and principal administrative officer of the Southeast Asia Command. In this capacity, he directed lend-lease to all allied forces in that area. In 1945 Wheeler became Commanding General, United States Forces in the China-Burma-India Theater, and in September 1945, he served as the United States representative at the Japanese surrender ceremonies in Singapore.

Wheeler was appointed Chief of Engineers in October 1945 and served in this position until 1949. Following the Egypt-Israel War in 1956 he was appointed Chief United Nations representative in clearing the Suez Canal, a job completed in three months, well under the one-year estimate. In 1960 he supervised dredging of the mouth of the Congo River to allow ocean shipping to go 80 miles upriver.

He retired with the rank of lieutenant general, and served as engineering advisor to the International Bank for Reconstruction and Development. General Wheeler died on February 9, 1974.

Colonel Earl E. Gesler

Earl Ewart Gesler was born in Illinois on March 11, 1893. He graduated from the United States Military Academy in 1915. In 1916-17, he participated in the Punitive Expedition into Mexico.

During World War I, Gesler held temporary ranks as captain (1919) and major (1920). He received permanent promotion to captain in 1922 and to major in 1923.

From 1920 to 1924, he held the rank of Assistant Professor of Military Science at Iowa State University at Ames. In 1928 he served as an instructor with the National Guard.

Gesler first served as Acting District Engineer at Rock Island from October 10, 1935, to August 13, 1936. He was then promoted to lieutenant colonel and appointed District Engineer, serving until August 4, 1939. During his tour of duty he directed completion of the remaining locks and dams for the 9-foot channel. The last one, Lock and Dam 14 at Le Claire, Iowa, was completed just two months before the end of his tour. He also supervised the first specifically authorized flood control projects in the District, 14 of which were authorized by the Flood Control Act of 1936.

Gesler left the Rock Island District in 1939 to take charge of the Contract and Finance Section of the Office of the Chief of Engineers. From 1943-46, he was Division Engineer of the Mid-Atlantic Division, and in 1949-50, he was District Engineer at Philadelphia. Colonel Gesler died in Chicago, Illinois, on August 11, 1958.

Major General Charles P. Gross

Charles Philip Gross was born in New York on March 14, 1889. He graduated third in his class from the United States Military Academy in 1914. He was promoted to captain, Corps of Engineers, in 1917 and served in Europe with the American Expeditionary Force.

Following promotion to major in 1920, he completed a Master of Arts degree in engineering at Cornell University in 1921. He served as Instructor of Engineering at West Point in 1922-23, and as Instructor in Tactics from 1923-26.

From 1927-29, Gross was District Engineer at Los Angeles. He served as officer-in-charge of a barge canal survey in Nicaragua in 1929. He became District Engineer at Rock Island on November 24, 1939, and served until January 28, 1941. During this period he supervised preliminary planning and survey work for Coralville Reservoir, the first of the flood control reservoirs authorized in the District.

Following his tour of duty at Rock Island, Gross served as Chief of Transportation Division of the Harriman-Beaverbrooke mission to London and Moscow in 1941-42. He also handled transportation arrangements for the Quebec, Malta, Yalta, and Potsdam conferences of Allied leaders during World War II. During the War he also served as Chief of the Army Transportation Corps and ran the national railroads after they were taken over by the Government.

Following retirement from the Army in 1945 with the rank of major general, Gross accepted a position as Chairman of the Board of Transportation for the City of New York. General Gross died on July 21, 1975.

Colonel Clinton W. Ball

Clinton W. Ball served a short term as District Engineer at Rock Island from January 29, 1941, until May 15, 1942. He supervised construction of the one-story building immediately west of the Clock Tower Building. From 1942 until 1981 this unit housed the District garage. It currently houses the automatic data processing center, comptroller and finance and accounting offices, the procurement and supply division, foundations and materials branch, and two conference rooms. Much of the military construction supervised by the Rock Island District during World War II was also begun under Ball's supervision.

Colonel Ball retired from the Army and became a licensed civil and mining engineer in San Marcos, Texas.

Colonel William J. Matteson

William Joseph Matteson was born in Illinois on June 13, 1903. He graduated from the United States Military Academy in 1928 and was commissioned a second lieutenant in the Corps of Engineers.

As with his predecessor, Matteson's tour of duty as District Engineer at Rock Island was brief, from May 16, 1942 to February 15, 1943. During this time he was promoted from lieutenant colonel to colonel. Because of World War II, almost no civil

works were carried on during this period. Extensive military construction continued, however, both on Arsenal Island and in the field.

Following his tour of duty at Rock Island, Matteson became Executive Officer of the Engineer Board at Fort Belvoir, Virginia. He served there until 1946, when he retired from the Army. He later served on the Board of Transportation of the City of New York under General Charles Gross, and was associated with the American Institute for Economic Research. Colonel Matteson retired to Great Barrington, Massachusetts, where he died on April 3, 1974.

Lieutenant Colonel John H. Peil

John H. Peil was the only Rock Island District Engineer to serve the Rock Island District both as an officer and as a civilian. In both capacities he served the District from 1931 until his retirement in 1965.

Prior to coming to the Rock Island District as resident engineer in charge of Locks and Dams 15 and 20, Peil worked for the Louisville, Kentucky, District, and on the construction of locks and dams on the Ohio River. He received a degree in civil engineering in 1924.

When Lock 20 was completed in February 1936, Peil transferred to the Rock Island District Office to head the District construction section. From August 1940 to 1942, he served as engineer in charge of the planning section of the Engineering Division.

In July 1942 he was commissioned as major in the Corps of Engineers. He continued with his engineering assignments until February 1943 when he was promoted to lieutenant colonel and reassigned as

District Engineer at Rock Island. Peil served as District Engineer from 1943 to April 1946. During and after World War II he supervised the design and construction of more than $80,000,000 in military construction projects, as well as supervising major flood fighting efforts on the Des Moines, Rock, and Mississippi Rivers in 1944, 1945, and 1946. On February 1, 1946, Peil was awarded the Legion of Merit for his work and the work of the District during the War.

Peil returned to his civilian engineer status in 1946 to become chief of the Engineering Division of the Rock Island District and chief technical assistant to District Engineers. He retired in December 1965 and accepted a position as Assistant Professor of Mathematics at Culver Stockton College in Canton, Missouri. For the past two years he has lived in New Bern, North Carolina.

Colonel William N. Leaf

William Newton Leaf was born in Pennsylvania on December 14, 1898. Following graduation from the United States Military Academy in 1923, he was commissioned second lieutenant in the Corps of Engineers. He attended Cornell University in 1925-26, from which he received a graduate degree in civil engineering.

From 1943-45, Leaf served with the 592nd Engineer Company, Amphibious Regiment, 6th Army, Southwest Pacific, Philippine Theater. He arrived in Rock Island as District Engineer on April 9, 1946. His tenure as District Engineer marked a period of return to civil works which had been interrupted by the War. Most of the District work during his tour of duty involved emergency and regular (authorized) flood control projects.

Colonel Leaf died on June 1, 1948, while serving as Rock Island District Engineer.

Colonel Reginald L. Dean

Reginald Langworthy Dean was born in Rock Island, Illinois, on March 24, 1901. He graduated from the United States Military Academy in 1924 and was commissioned a second lieutenant. He attended Cornell University and graduated with a degree in civil engineering in 1926. During the 1930's, he taught at the United States Military Academy.

During World War II, Dean served with the construction section of the Far East Command in Australia, New Guinea, and the Philippines. In 1945 he served with the Luzon Engineer District, and after the War became Assistant Engineer of the Eighth Army in Japan.

Dean began his tenure as District Engineer at Rock Island on June 21, 1948, and remained until September 1, 1950. A series of floods from 1943 through 1948 kept the emergency flood protection work high in the District through Dean's tenure. In addition, work on the Coralville Reservoir continued. The earth embankment portion of the dam was completed in 1950.

Following his tour as District Engineer, he was assigned as Engineer with the 5th Corps at Fort Bragg. He retired to East Brunswick, New Jersey, where he died on August 8, 1966.

Colonel George A. Finley

George Alexander Finley was born in Pennsylvania on April 3, 1914. He graduated from the United States Military Academy in 1936 and went on to earn a Master of Science in Engineering from Cornell University in 1939. He served with the U.S. Airforce from 1942 to 1945.

Finley served as Rock Island District Engineer from September 5, 1950, to June 1, 1953. Although a major flood in the spring in 1951 kept the District active, the Korean War severely curtailed civil

works projects during this period. The only major work was on the new 1200-foot lock at Keokuk, continued only because of the importance of an open channel to national defense.

Following his tenure as Rock Island District Engineer, Finley served as District Engineer of the Corps' Okinawa District in the Far East in 1956-57. He then organized the Canaveral District in Florida in 1963 to supervise Air Force and space construction in the Cape Kennedy area. The Canaveral District more than doubled in size and completed nearly $145,000,000 worth of construction projects during the 16 months it was headed by Finley.

Finley retired from the Army in 1964, and taught engineering at a junior college in Miami, Florida. In 1966 he accepted a position as Dean of the Engineering School at Guilford College in Greensboro, North Carolina. He now lives in Raleigh, North Carolina.

Colonel Nelson Leclair, Jr.

Nelson Leclair, Jr. served as District Engineer at Rock Island from July 1, 1953, until February 28, 1955. He is a graduate of Norwich University, Northfield, Vermont.

Prior to World War II, Leclair worked for several years with the Illinois Division of Highways. During World War II he served in the 372nd Engineer Regiment in the European Theater as part of General Patton's Third Army. After the War he served for two years as Deputy Foreign Liquidation Commissioner for Latin America in South America, and for two years in a similar capacity in Paris. He then served in the Office of the Chief of Engineers until his assignment to Rock Island.

Leclair's years at Rock Island were marked by the continued low number of civil projects due to the

Korean War. Expenditures for civil projects reached an all-time 20th century low of $250,000 in 1954. Consequently, the District faced the possibility of having its duties transferred to the St. Paul and St. Louis Districts, a move that was forestalled by the combined efforts of area citizens and congressional representatives.

Following his retirement from the Army in 1955, Colonel Leclair has served as vice president for the Iowa-Illinois Gas and Electric Company of the Rock Island-Davenport area. He now lives in Bettendorf, Iowa.

Colonel John L. Wilson, Jr.

John L. Wilson, Jr. served as District Engineer at Rock Island from March 1, 1955, to July 31, 1958. In the 1930's, Wilson was an architect and engineer in private practice in San Antonio, Texas. From 1939 to 1941 he was chief architect for the Southwest Texas Division of the Federal Housing Administration.

In 1941 Wilson went on active duty with the Army, and supervised the construction of airfield and army camps in the Southwest during the War. In 1946 he left the service and resumed private practice as an architect-engineer in San Antonio, Texas.

He became a major in the Corps of Engineers in 1947 and served as Engineer of the Western Area Command of the U.S. Army in Europe in 1953-54, prior to coming to Rock Island. During Wilson's tenure as District Engineer, the Rock Island District went through another crisis of possible merger with the St. Paul District, a possibility again avoided by strong local support from cities, citizens, and river interests. These years also saw completion of the Coralville Reservoir and a gradual increase in appropriations following the lean Korean War years. Colonel Wilson is now retired and lives in Brandenton, Florida.

Colonel Edmund M. Fry

Edmund M. Fry was born in Ardmore, Oklahoma, on October 27, 1916. He was commissioned in the Corps of Engineers in 1938 following graduation from the University of Oklahoma with a Bachelor of Science degree in civil engineering.

During World War II, Fry commanded the 12th Engineer Battalion in Europe. He was captured by the enemy in France, but escaped a few days later to rejoin his unit. After returning to this country, Fry attended the Command and General Staff College, Fort Leavenworth, Kansas, and then completed a Master's degree in civil engineering from Iowa State University.

From 1948 to 1952, he was Staff Engineer, General Headquarters, Far East Command. During 1952 he attended the Armed Forces Staff College, Norfolk, Virginia. From 1952 to 1955 Fry was at the Engineer School at Fort Belvoir, Virginia, and in command of the 79th Engineer Construction Group. Just prior to his assignment to Rock Island, he was Engineer for the Southern Area Command, U.S. Army Europe, Germany, from 1955-58.

Fry was District Engineer at Rock Island from August 6, 1958, to July 21, 1961. During this period the Saylorville Reservoir was authorized and entered the planning stage, and the first construction was finally begun on the long-interrupted flood control reservoir at Red Rock, Iowa, on the Des Moines River.

Following his tour of duty at Rock Island, Fry attended the Army War College before proceeding to an assigment in Korea. In 1964 he was assigned to duty with the North Central Division of the Corps of Engineers where he remained until his retirement from the Army on May 31, 1966. He now lives in Oklahoma City, Oklahoma.

Colonel Richard L. Hennessy

Richard L. Hennessy was born on December 8, 1919, in New York City. He graduated from the United States Military Academy in 1943 and served in Europe with the 110th Engineer Combat Group during World War II.

Following the War, Hennessy completed a Master's degree in civil engineering at Iowa State University. He was stationed at Fort Belvoir, Virginia, from 1947 to 1950, and then served as project engineer and battalion commander from 1950 to 1952, during the Korean War. From 1953 to 1956 he served as Chief of the Military Assignments Branch in the Office of the Chief of Engineers. He then served three years as a resident engineer and Assistant District Engineer for Operations in the Alaska Engineer District. In 1960-61, he was Commanding Officer of the 160th Engineer Group at Fort Knox, Kentucky.

Hennessy served as District Engineer at Rock Island from July 24, 1961, until his retirement from the Army on June 30, 1964. The primary responsibilities of the District during this period were flood control projects. Following retirement, Hennessy taught engineering at Michigan Institute of Technology at Houghton, Michigan. He now lives in Linden, Michigan.

Colonel Howard B. Coffman, Jr.

Howard Beverly Coffman, Jr. was born in Hopkinsville, Kentucky, on November 23, 1919. He graduated from the United States Military Academy in 1943 and was commissioned in the Corps of Engineers.

During World War II he served with the 311th Engineer Battalion (Combat), 86th Infantry Division. He participated in the campaign of Central Europe and served in the Philippines.

Following the War, Coffman completed a Master's degree in civil engineering at the University of Iowa. He attended the Engineer School at Fort Belvoir, Virginia; the Command and General Staff College, Fort Leavenworth, Kansas; and the Armed Forces Staff College, Norfolk, Virginia. In addition to tours of duty in Okinawa, Korea, and Germany, he also served in the Office of the Chief of Engineers and in the Office of the Deputy Chief of Staff for Military Operations prior to coming to Rock Island.

Coffman became Rock Island District Engineer on July 1, 1964, and remained until July 10, 1967. During this period the District celebrated its centennial. His tour of duty was marked by the 1965 flood, worst in the District's history, and by a rapidly increasing work load as several major flood protection projects got under way.

He served a second tour of duty in Germany after leaving Rock Island. He then went to Vietnam, where he was Deputy Brigade Commander of the 18th Engineer Brigade and then Deputy Commander of the U.S. Army Engineer Command, Vietnam. Coffman served as Deputy Division Engineer for Civil Works of the Southwestern Division of the Corps of Engineers at Dallas, Texas, from 1971 to 1973, when he retired from the Army. He is now with Texas Utilities Service Inc. of Dallas.

Colonel Walter C. Gelini

Walter C. Gelini was born in Collier, West Virginia, on June 11, 1924. He graduated from the United States Military Academy in 1945 and was commissioned in the Corps of Engineers. He first served in Korea as a company commander for three years. He then spent four years with the Armed Forces Special Weapons Project at Sandia Base, New Mexico. In 1954 he received a Master of Science degree in civil engineering from Harvard University.

Gelini served two years in Korea from 1954 to 1956 with the 169th Engineer Group and the Eighth Army. He next served in Washington, D.C., as a staff officer in the Planning Studies Division, Army Map Service, and was graduated from the Command and General Staff College, Fort Leavenworth, Kansas. From 1957 to 1960 he was an instructor at the United States Military Academy.

In 1960 he was assigned to the Mediterranean Division of the Corps of Engineers and served for two years as Assistant and Area Engineer at Immir, Turkey. Following graduation from the Army War College in 1963, he completed a Master of Arts degree in international affairs at George Washington University in Washington, D.C.

Gelini commanded the 17th Engineer Battalion, and Armoured Division, Fort Hood, Texas, in 1963-64. After a year in Washington, D.C., as an Army staff officer in the Pentagon, he commanded the 921st Engineer Group at Fort Leonard Wood, Missouri, going to Vietnam with that group. Upon deactivation, he assumed command of the 79th Engineer Group.

He became District Engineer at Rock Island on August 21, 1967, remaining until January 18, 1970. During his tenure as District Engineer, Red Rock Dam was completed and put into operation, another link in the increasing chain of permanent flood protection works in the District. In 1969 Gelini was presented the Army Meritorious Service Medal for exceptional service in emergency preparation work and flood fighting activities during the spring floods of that year on the Mississippi and Des Moines Rivers.

In January 1970, Colonel Gelini was assigned to become Commanding Officer of the Mobility Equipment Research and Development Center at Fort Belvoir, Virginia. However, he became ill shortly thereafter and died on May 17, 1970, at Walter Reed Hospital in Washington, D.C.

Colonel James E. Bunch

James E. Bunch was born in Comanche, Oklahoma, on September 29, 1921. He was commissioned in the U.S. Army Corps of Engineers in 1949 following his graduation from Oklahoma State University, Stillwater, Oklahoma. In 1955 he completed a Master's degree in civil engineering from Iowa State University, Ames.

His military education included graduation from the Engineers School, Fort Belvoir, Virginia; Command and General Staff College, Fort Leavenworth, Kansas; Armed Forces Staff College, Norfolk, Virginia; and the Army War College, Carlisle Barracks, Pennsylvania.

Prior to coming to the Rock Island District, Colonel Bunch served in Vietnam and had assignments at Fort Belvoir, Virginia; Goose Bay, Labrador; Fort Wainwright, Alaska; Fort Wolters, Texas; and in the Office of the Chief of Engineers, Washington, D.C.

Colonel Bunch became District Engineer at Rock Island on January 19, 1970, and served until July 31, 1972. Following his tour of duty at Rock Island, he became Chief of the Office of Personnel Administration in the Office of the Chief of Engineers. He retired from the Army in September 1974 and now lives in Soldotna, Alabama.

Colonel Walter H. Johnson

Walter H. Johnson was born on February 26, 1928, in Sioux Falls, South Dakota. He was commissioned in the Corps of Engineers in 1951 upon graduation from the United States Military Academy.

His military training included graduation from the Engineer School, Fort Belvoir, Virginia; Command and General Staff College, Fort Leavenworth, Kansas; and the Army War College, Carlisle Bar-

racks, Pennsylvania. He also earned a Master of Science degree in civil engineering from Texas A&M, and is a registered professional engineer in New York State.

Johnson has served tours as Branch Chief in the Construction Division of the Office of the Deputy Chief of Staff for Logistics, Department of the Army; as a staff officer with II Field Force, Vietnam; as Commander, 83d Engineer Battalion (Construction), U.S. Army, Europe; as an assistant professor at the United States Military Academy; as Commander, 161st Engineer Company (Missile Command), Korea; and as Assistant to the Division Engineer and Executive Officer, New England Division of the Corps of Engineers.

Immediately prior to coming to Rock Island, he served as Assistant to the Deputy for Installations and Housing, Office of the Assistant Secretary of the Army (Installations and Logistics). Colonel Johnson became the 33rd District Engineer at Rock Island on August 1, 1972. In addition to another major flood in the spring of 1973, his tour was marked by increasing multi-purpose river development and increasingly complicated ecological concerns. Colonel Johnson was assigned as Commander of DARCOM Installation and Services at the Rock Island Arsenal on July 25, 1975. He retired from the Army in October 1977, and now lives in Jefferson City, Missouri, where he is Chief of the Division of Design and Construction, Office of Administration, for the State of Missouri.

Colonel Daniel L. Lycan

Daniel L. Lycan was born in Decatur, Illinois, on February 26, 1931. He was commissioned in the Regular Army as a Distinguished Military Graduate from senior ROTC at the Massachusetts Institute of Technology, Cambridge, Massachusetts, in 1952. He graduated from MIT with a Bachelor of Science in civil engineering and continued through a M.S. and Ph.D. in civil engineering from the University of Illinois. He also graduated from the Army War College and the Army Command and General Staff College, and is a registered professional engineer in the State of Mississippi.

Prior to coming to Rock Island, Lycan held responsible command and staff assignments in the United States and overseas. He has served with engineer combat and construction troops at Fort Campbell, Kentucky, and in Germany. He has served on the staff and faculty of the Army Engineer School, Fort Belvoir, Virginia; as Assistant to the Director, U.S. Army Engineers Waterways Experiment Station, Vicksburg, Mississippi; and as Construction Engineer Advisor, Logistics Division, Military Assistance Advisory Group, Vietnam.

Lycan also served as Technical Assistant to the Deputy Chief of Engineers for NASA Support, Office of the Chief of Engineers, Washington, D.C.; as the Department of the Army representative for the Department of Defense Manned Orbiting Laboratory Space Program; as Commander, 84th Engineer Battalion (Construction), Vietnam; as Commander, 45th Engineer Group (Construction), Vietnam; as Chief, Engineer Operations Advisory Branch, U.S. Military Assistance Command, Vietnam; and as Deputy Commander and then Commander, U.S. Army Computer Systems Command Support Group, Presidio of San Francisco, California.

He has been awarded the Legion of Merit, Meritorious Service Medal with Oak Leaf Cluster, Army Commendation Medal with two Oak Leaf Clusters, the Air Force Commendation Medal, the Vietnamese Gallantry Cross with Silver Star, and the Republic of Vietnam Honor Medal 1st Class.

Lycan became District Engineer at Rock Island on July 28, 1975, and remained until August 18, 1978. During his tenure in office, Saylorville Reservoir was completed and placed in operation. Low water, rather than flooding, during this period, created most of the problems for the District. As District Engineer, Colonel Lycan firmly and professionally guided the District through a number of important projects and new directions such as environmental concerns. He left the Rock Island District to become Commander and Director of the Corps of Engineers Topographical Laboratory, Fort Belvoir, Virginia. He retired from the Army in August 1981 to become Director of Public Works for Prince William County, Virginia.

Colonel Frederick W. Mueller, Jr.

Frederick W. Mueller is a native of Atlanta, Georgia. He graduated from the Citadel, the Military College of South Carolina, with a Bachelor of Science degree in civil engineering. He earned a Master's degree in civil engineering from Purdue University, and is also a graduate of the Army Engineer School, the Army Command and General Staff College, and the Naval War College. He is a registered professional engineer in the State of Wisconsin.

He began his military career in 1955 as a Platoon Leader in the 23rd Armored Engineer Battalion of the Third Armored Division at Fort Knox, Kentucky. He later became Aide de Camp to the Commanding General of the Division after it arrived in Germany. This was followed by additional troop assignments in Germany with the 63rd and 299th Combat Engineer Battalions. Mueller also served in Vietnam during the 1964 "build up," and in Korea during the 1967 "Pueblo Incident."

He has been Deputy Chief of the Army Geodetic Satellite Tracking Program at the Army Map Service; a Plans and Operations Advisor to the RVN,

Corps of Engineers; Company Commander and Operations Officer in the 326th Engineer Battalion; 101st Airborne Division, Fort Campbell, Kentucky; Chief, Operations Branch, Headquarters 8th U.S. Army Engineer Section, Korea; Staff Officer in the Directorate of Installations of the Deputy Chief of Staff for Logistics in the Pentagon; and Commanding Officer of the 83rd Engineer Battalion (Construction) and the 46th Engineer Battalion (Construction) at Fort Rucker, Alabama. From April 1, 1972 to July 22, 1974, he was Deputy District Engineer for the Seattle District. From July 1975 to July 1978 he served with the Organization of the Joint Chiefs of Staff as Logistics Staff Planner to the U.S. Military Representative to the NATO Military Committee, Brussels, Belgium.

He has received the Legion of Merit, Bronze Star, Meritorious Service Medal and two Oak Leaf Clusters, and the Army Commendation Medal and two Oak Leaf Clusters.

Mueller became District Engineer at Rock Island on August 19, 1978. In addition to the continuing responsibilities for new and existing flood control projects, he supervised a major expansion of District boundaries to include the Illinois Waterway System. He remained District Engineer until March 9, 1981, when he was temporarily assigned to the North Central Division as Deputy Division Engineer for Upper Mississippi River Basin Commission Activities in St. Paul. In July 1981 he was assigned as Resident Member of the Board of Engineers for Rivers and Harbors at Fort Belvoir, Virginia.

Colonel Bernard P. Slofer

Bernard P. Slofer is a native of Iowa City, Iowa. He was a distinguished military graduate of the University of Iowa in 1957 with a Bachelor of Science degree in mechanical engineering. He has also graduated from the U.S. Army Engineer School, the U.S. Army Command and General Staff College, and the U.S. Army War College.

His command assignments include a tour as Company Commander in the 3rd Engineer Battalion, Germany, in 1962; advisor to the Vietnamese 52nd Engineer Battalion, U.S. Military Assistant Command, Vietnam in 1964-65; Commander of the 59th Engineer Company, Fort Ord, California, from 1965 to 1967; Resident/area Engineer, Kaiserslautern-Ramsteing, Germany from 1969 to 1971; Commander, 549th Engineer Battalion, Germany, from 1975 to 1977; and Deputy Brigade Commander, 130th Engineer Brigade, Frankfort, Germany, in 1977-78.

Major staff assignments include: Deputy District Engineer, Rock Island District, from 1972 to 1975; Facilities Engineer, U.S. Army Area, Sattahip, Thailand, in 1968-69; Chief, Intelligence Area Analysis Team, Fort Shafter, Hawaii, in 1967-68; Operations Officer, Headquarters, 1st Engineer Battalion, Fort Riley, Kansas, in 1963; and Construction Engineer, Defense Atomic Support Agency, Mercury, Nevada, in 1962.

Among his military awards are the Bronze Star Medal, Meritorious Service Medal (three awards), and Army Commendation Medal (two awards).

Slofer returned to the Rock Island District to become District Engineer on July 15, 1981.

Appendix B

Distinguished Civilian Employees

Chiefs, Engineering Division, Rock Island District

In order to establish continuity in the work of the Upper Mississippi River improvement, given the relatively short tours of duty of the District Engineers, the Rock Island District as early as the 1880's established a policy of appointing one civilian employee as the District Engineer's principal assistant. The position has held several titles: Principal Assistant Engineer, Senior Engineer, and, since the formation of an engineering division in 1944-46, Chief of the Engineering Division.

One indication of how much continuity this arrangement provided is that in its 115-year history, the Rock Island District has had only six principal engineers: C.W. Durham, Richard Monroe, H.G. McCormick, Lieutenant Colonel John H. Peil, Frank W. Ashton, and Doyle W. McCully. Brief biographies of these men follow, with the exception of Colonel Peil, whose biography will be found among the District Engineers.

C.W. Durham

Charles William Durham was born in Maine where his father was a lumber merchant. He graduated from Harvard University in 1868, and from 1869-70 did graduate work in engineering at the University of Heidelberg, Germany, and at the Institute of Technology at Boston. In 1870 he was employed by the C.B.&Q. Railroad in Nebraska.

Durham came to Rock Island as an assistant engineer for the Rock Island District in 1871. He began

work as a civil engineer on the Rock Island Rapids project, but was soon assisting with many of the reports and surveys being undertaken by Colonel Macomb. He participated in the construction of the first experimental wing dams on the Upper Mississippi River in 1873, and the following year assisted Montgomery Meigs in the survey and report that led to the use of wing dams as the principal means of channel improvement.

In 1876 Durham was appointed Captain of the snagboat *Montana*, retaining this position for several years. Gradually, he assumed more and more responsibility for supervising projects in the District. He was placed in charge of snag and dredge boats, and of all matters relating to bridges in the District. Durham worked particularly closely with Colonel Alexander Mackenzie, District Engineer from 1879 to 1895. Sometime during this period he came to be known, unofficially, as Principal Assistant Engineer.

Apparently this title remained an unofficial one until Durham retired in 1920 after 50 years of service with the District. Letters in the Rock Island District files show that Durham queried each new District Engineer in turn about retaining that title.

Durham's valuable contributions extended beyond the Corps of Engineers during his long stay in Rock Island. He served the community in many ways. For four years, as a Colonel in the Illinois National Guard, he served as Aide-de-Camp to the Governor of Illinois. He served on the Rock Island Public Library Board for six years and on the Board of Education for nine. He was a member of the Masonic Lodge and a member and officer of many local service clubs.

For nearly all of his 50 years in Rock Island, Durham resided in a large mansion on the southeast corner of 11th Street and 1st Avenue.

In 1920 Congress passed new pension and retirement laws. Along with a number of other employees long past retirement age in the District Office,

Durham retired on July 31, 1920, with a pension of $720 per year. Following retirement he moved to LaMesa, California, to be near his daughter.

Richard A. Monroe

Richard A. Monroe was born in Mt. Pleasant, Iowa, on December 24, 1867. Following graduation as a structural engineer, he worked for several Midwestern and Western railroads as lineman, chainman, and topographer. He entered Government service as an employee of the Rock Island District on September 22, 1894.

Except for a brief period of low activity in the District in 1901-02, when he took local charge of double track construction for the Chicago, Burlington, and Quincy Railroad, Monroe served continuously with the Rock Island District until his retirement on December 31, 1937. He served in several positions: as surveyor and inspector on levee work and other flood control projects, as inspector on the construction of rock and brush dams and shore protections under contract, as assistant in charge of similar work done by hired labor and Government plant, on hydraulic dredging, and on construction of the Moline and LeClaire locks. He also played an active part on the construction, operation, and maintenance of the large District fleet.

In 1920, following the retirement of C.W. Durham, Monroe was named Principal Civilian Assistant to the District Engineer. As engineering work on the Upper Mississippi increased in the 1920's, especially as the 9-foot channel project approached, organization in the District Office grew more complex. Consequently, on November 1, 1929, Monroe was promoted to the newly-created post of Senior Engineer.

During construction of the District's 12 locks and dams for the 9-foot channel, Monroe served primarily as a consultant in the Operations Division,

handling the many problems of which his wide background had made him knowledgeable. In 1934 he was named Civilian Assistant to the District Engineer in the Operations Division, in addition to his title of Senior Engineer.

Monroe was widely respected by those with whom he worked. An old friend and fellow employee said of him, "Monroe doesn't always deliver the goods by express. Sometimes they come by freight, but you can bet that when the consignment arrives you will always find it complete; all the goods are there, properly labeled and ready for use." (Quoted in the Rock Island District publication, *Safe Channel*, December, 1937, p. 35.)

Following his retirement, Monroe remained in Rock Island, enjoying a wide range of interests from astronomy to shorthand and bridge. He died on August 7, 1945, in Rock Island.

H.G. McCormick

H.G. McCormick was born in Fairfield, Virginia, on August 16, 1876. He graduated from Virginia Polytechnic Institute in Blacksburg, Virginia.

McCormick was transferred into the Rock Island District in April 1930 after more than 20 years with the Corps of Engineers on the Ohio and Lower Mississippi Rivers. He became Head Civilian Engineer in 1937, following Monroe's retirement, and remained at that post until his own retirement in 1946.

McCormick was noted for his work on the design and construction of locks and dams for the 9-foot channel. Employees in the District remember him especially for the guidance and counsel he gave on that project to young engineers who went on to serve the District well.

Frank W. Ashton

Frank W. Ashton was born in Clinton, Iowa, in 1908. He graduated from the University of Iowa in 1930 with a Bachelor of Science degree in civil engineering. For two years after graduation, he worked as a structural engineer for the American Bridge Company in Gary, Indiana.

He joined the Rock Island District as a structural engineer in 1933. From 1933 until World War II, he worked on the design of gates for the navigation dams on the 9-foot channel project.

Ashton was commissioned as a captain in the Army in July 1942 and assigned as chief of construction work to convert the old Bettendorf Company plant in Bettendorf, Iowa, into the Quad City Tank Arsenal. Following completion of this project in 1943, Major Ashton returned to the District Office as chief of military construction for the Rock Island Arsenal and Military Head of the Engineering Division. He was discharged with the rank of lieutenant colonel in 1946.

From 1946 until he became Chief of the Engineering Division in 1966, Ashton served under John Peil as assistant chief of that division. Among Ashton's achievements as Chief of the Engineering Division was supervision of the design of the three Iowa flood control reservoirs and new Lock 19 at Keokuk, Iowa. In addition, he was active in many flood protection projects in the District.

In 1966 Ashton was appointed Flood Executive Officer. He coordinated the District's flood control efforts during the 1967 flood and again in 1969 and 1971.

Ashton received two meritorious civilian service awards, the second highest civilian award presented by the Corps of Engineers. The first was for his work as Flood Executive Officer during the Operation Foresight flood emergency program in 1969, and the second, in 1973, was in recognition of his understanding and resourcefulness as an engineer.

He was a registered professional engineer in Iowa, a fellow of the American Society of Civil Engineers, and a member of the Society of American Military Engineers.

Frank Ashton retired on June 29, 1973, after 40 years with the Rock Island District. He died on November 21, 1973.

Doyle W. McCully

Doyle W. McCully, the present Chief of the Engineering Division and chief engineer consultant of the Rock Island District, was born in Tupelo, Mississippi. He graduated from the University of Mississippi in 1958 with a civil engineering degree and began his career with the Corps of Engineers in the Ohio River Division, Cincinnati, Ohio, as a Junior Engineer Trainee assigned to the District Office in Huntington, West Virginia.

In 1959 he transferred to the Design Branch of the Huntington District Office, where he worked until 1967. During this time he had various design responsibilities, including local flood protection projects, channel rectifications, erosion control and protection and navigation projects on the Ohio River.

McCully transferred to the Office of the Chief of Engineers in Washington, D.C., in 1967, where he was assigned to the Planning Division of Civil Works, managing design memoranda for civil works projects and conducting studies for water resources planning and policy matters. In August 1970 he was promoted to Chief of the Cost Allocation Section. From December 1971 to June 1972, he supervised authorization planning activities, including material to be used by officers appearing before Congressional Public Works Committees.

McCully received a Master's degree in civil engineering in the field of water resources engineering

from Catholic University in Washington, D.C., in 1971. Immediately prior to his assignment to the Rock Island District, he was Senior Regional Planning Engineer in the Urban Studies Branch of the Office of the Chief of Engineers, with overall management responsibilities for several urban studies programs throughout the United States.

He replaced Frank Ashton as Chief of the Engineering Division with the Rock Island District on October 15, 1973. He is a registered professional engineer in the State of Mississippi, a member of the American Society of Civil Engineers, and a past president of the Huntington, West Virginia, post of the Society of American Military Engineers. In 1980 McCully was honored as Senior Engineer of the Year by the Quad-Cities Engineering and Scientific Council.

District Gallery of Distinguished Civilian Employees

Within the Rock Island District, a standing committee meets as needed to consider outstanding former District employees for election to the District Gallery of Distinguished Civilian Employees. This committee is chaired by the Chief of the Personnel Office, and includes the Chiefs of the Engineering, Operations, and Construction Divisions, and the Deputy District Commander. Any civilian employee of the District may nominate a fellow employee who has achieved 30 or more years of credible service, 20 of which must be with the Corps of Engineers, or who has died in service after 15 years or more with the Corps. Candidates are eligible for nomination after they have died or been retired for at least two years. In order to be elected, the nominee must have performed "loyal and faithful service," accomplished assigned duties in an exceptional manner, developed or improved methods or procedures which produced extraordinary benefits, and contributed substantially to the reputation of the Corps of Engineers.

Thirteen former civilian employees have been elected to the District Gallery:

FRANK W. ASHTON	MONTGOMERY MEIGS
MYRTLE L. BURGE	ESTHER G. MUELLER
ROBERT E. CLEVENSTINE	JOHN H. PEIL
JAMES H. GROVE	HARLEY E. REEVES
FREDERICK A. HANSEN	WALLACE E. TURPIN
CARLETON E. KELLEY	L.L. WHEELER
H.G. McCORMICK	

Biographies of Frank W. Ashton and H.G. McCormick will be found in Appendix B, Chiefs of the Engineering Division. John Peil's biography will be found in Appendix A, District Engineers, Rock Island District, while an account of Montgomery Meigs will be found in the Afterword. Brief biographies of the remaining Distinguished Civilian Employees follow.

Myrtle L. Burge

Myrtle Burge was born in Castlewood, South Dakota, on August 11, 1885. She graduated from Faulkton, South Dakota, High School and from the School of Education of Dakota Wesleyan College. She was appointed a Clerk in the Adjutant General's Office in Washington, D.C., in 1918. Nine years later, on July 1, 1927, she came to the Rock Island District. She was appointed Chief of the Personnel Section in 1935, remaining in that position until she left in October 1945 on a disability retirement. Miss Burge was the first female department head in the Rock Island District at what is now Staff level.

Robert E. Clevenstine

Robert Clevenstine was born in Rock Island, Illinois on October 8, 1904. He graduated from the University of Illinois with a Bachelor of Science degree in electrical engineering. He began his career with the Rock Island District as an inspector of concrete materials during construction of Lock 20 at Canton, Missouri. He was promoted to Office Engineer, then Assistant Resident Engineer, and finally Resident Engineer for the completion of Dam 20 and for the water supply and sewer system and power and lighting contract at Lock and Dam 20. Clevenstine also supervised the installation of water supply systems at both Lock and Dam 21 at Quincy, Illinois, and Lock and Dam 22 at Saverton, Missouri. In 1936 he transferred to the District Office in the Clock Tower Building, and assumed responsibility for estimating, and construction contract administration. In 1938 he worked on the mechanical design of lock and dam machinery, including the early design of machinery for Lock 19 and later supervised the construction of that major navigation lock. In 1940 he became Assistant to the Chief of the Plant Section of the Operations Division, and was named head of that section in 1945. He was Assistant Chief of the Operations Division from 1949 until he was named head of the division in February 1955. Clevenstine received several awards and commendations, as well as a personal scroll from the Rock Island Arsenal in appreciation of outstanding liaison services during his 40-year tenure with the Rock Island District. He retired on June 30, 1973.

James H. Grove

James Grove was born in Mt. Carroll, Illinois, on July 14, 1893. He graduated from Rock Island (Illinois) High School. He was a member of Rotary International, serving as District Governor of Illinois in 1959-60; the Society of American Military Engineers, Conservation Club, several Masonic organizations, and Modern Woodmen of America. Grove began his career as a skilled laborer with the Rock Island District in 1912, and progressed to positions of successively greater reponsibility. He

served as Chief of the Supply Division for 42 years, under 21 District Engineers. He received a commendation for supervising negotiations in connection with the termination of military supply contracts with a value of approximately $100,000,000 at the end of World War II. His duties later included supervising the inspection and shipment of military supply items, procured by the Corps of Engineers for all the Armed Forces, in an area comprising Iowa, Nebraska, and Rock Island County. Mr. Grove retired on May 31, 1962, after 50 years of service to the District.

Frederick A. Hansen

Frederick Hansen was born in Rock Island, Illinois, on December 11, 1906. He graduated from the University of Illinois with a Bachelor of Science in general engineering. In 1933 he became a Junior Engineer in the Rock Island District, assigned to the Design Section to assist with the 9-foot channel project. In 1940 he was assigned as Resident Engineer supervising major building construction at the Rock Island Arsenal. His career with the District was interrupted for three years of duty with the Navy during World War II. Following discharge with the rank of lieutenant in 1946, he returned to the District's Design Section. Hansen was transferred to the Construction Branch in 1947 to serve as liaison for the Corps of Engineers between architects and construction contractors for the design and construction of Veterans Administration Hospitals at Iowa City, Iowa, and Madison, Wisconsin. In 1949 he became management construction engineer in the Construction Branch and was later promoted to Chief of the branch. In this position, he supervised construction of the 1200-foot Lock 19 at Keokuk, Iowa, the Coralville Dam and Lake Project, Red Rock Dam and Lake, and the beginning of Saylorville Lake Project near Des Moines, Iowa. Mr. Hansen retired on June 30, 1973.

Carleton E. Kelley

Carleton Kelley was born in Aurora, Illinois, on July 13, 1903. He graduated from the University of Wisconsin with a Bachelor of Law degree. He was admitted to the Bar, and to the Supreme Courts of Wisconsin, Illinois, and Iowa, as well as to the United States District Court of the Western District of Wisconsin, the Northern District of Illinois, and the Southern District of Iowa. He began his career with the Corps of Engineers as an Assistant Attorney in the Chicago District Office. He transferred to the Rock Island District in 1933, becoming both the first District Counsel and the first Chief of the Real Estate Division, a combination which lasted until 1968. The broad knowledge and expertise gained in this dual role was unique in the Corps of Engineers. It involved serving as an advisor to 16 District Engineers, as well as guiding and directing the acquisition of about 300,000 acres of land. Kelley's insistence that every case be handled on its own merits in a fair and impartial manner established a reputation of personal dedication and example that was respected by colleagues and other members of the public alike. His knowledge of the law and its application to District operations gained him respect throughout the legal profession. Mr. Kelley was awarded the Commendation for Meritorious Civilian Service in 1944, 1947, and 1972. He retired on June 30, 1972.

Esther G. Mueller

Esther Mueller was born in Davenport, Iowa, on December 22, 1893, and graduated from Davenport High School in 1914. Reportedly the first female employee of the Rock Island District, she was appointed to a temporary position as Minor Clerk in 1915, with the provision that she would be terminated immediately upon certification of an eligible male by the Civil Service Board. Beginning at a salary of $40 per month, Miss Mueller's career with the Rock Island District over the next 36 years took

her through the ranks of Minor Clerk, Clerk, Principal Clerk, and Administrative Assistant. She was appointed Mail and File Supervisor in the Mail, Records, and Publications Section in 1946. Miss Mueller retired on January 31, 1951.

Harley E. Reeves

Harley Reeves was born on March 25, 1873, at Tampico, Illinois. He graduated from the University of Illinois in 1895 with a Bachelor of Science in engineering. He began working for the Government as a rodman in 1897 on construction of the Illinois and Mississippi Canal. He performed engineering services on the I&M Canal locks at Sheffield, Sterling, and north of Atkinson, Illinois. Following completion of the Canal, he remained in a supervisory capacity during the operation and maintenance of that waterway until he was transferred in 1915 to supervise construction of the Le Claire Canal at the head of the Rock Island Rapids. His technical skill and ingenuity was demonstrated in the planning and construction of the Le Claire Lock, a project completed entirely by Government plant and hired labor. In 1923 Reeves was given charge of the Northern Field Area of the Rock Island District until his sudden death on July 28, 1928.

Wallace E. Turpin

Wallace Turpin was born in Grayville, Illinois, on December 20, 1900. He began working with the Rock Island District in August 1931 as a member of the Survey Branch. He progressed to become Field Supervisory Surveying Technician, heading up the Survey Branch Office at Hannibal, Missouri, an area comprising approximately 6,300 square miles. He exercised technical supervision for planning and coordinating the work of field survey parties for all engineering, surveying, and mapping operations in this area. He contributed extensively to the planning and development of the Canton, Missouri, Flood Control Project, Bear Creek Reservoir, Pigeon Creek Reservoir, Fabius River Drainage

District, the Sny Flood Control Projects, South Quincy and South River Drainage Districts, and the study for the Hannibal Flood Control Project among others. His ability to maintain composure and effectiveness under pressure, adverse or changing conditions, gained him the respect, loyalty, and cooperation of all associated with him. Mr. Turpin retired on December 31, 1965.

L.L. Wheeler

L.L. Wheeler was born in Jackson, Michigan, in 1851. He graduated from the University of Michigan in 1874 with a degree in engineering. He began his career with the Corps of Engineers in 1890 when he was hired as an Assistant Engineer for construction of the Illinois and Mississippi Canal. He was directly responsible for the Milan, Western, and Feeder sections of the Canal. In addition, he designed many of the lockmasters' houses and other buildings on the Canal property, and assisted in the design of the concrete lock structures—the first use of structural concrete in the United States. Following the completion of the Canal in 1906, and its transfer to the Rock Island District, Wheeler became Superintendent of the Canal, remaining with the District until he retired in 1921.

The Rock Island Clock Tower Building. Originally Storehouse A, the first building of the Rock Island Arsenal, it has been the home of the Rock Island District since 1934.

Appendix C

The Rock Island Clock Tower Building

The headquarters of the Rock Island District is on Arsenal Island in the Mississippi River between Davenport, Iowa, and Rock Island, Illinois. For most residents of that large urban area, the presence of the Engineers is represented not by the locks and dams which have so changed the nature of the channel, but by the imposing Rock Island Clock Tower Building, home of the District Office. The story of this building has become an integral part of the lore of the Rock Island District.

As with many other Engineer Districts, the Rock Island District was originally located in a federal building housing other federal offices. The Rock Island Federal Building housed the post office on the first floor, with the Engineers on the second and third floors. These quarters had been comfortable until 1930, when the rapid increase in personnel resulting from the 9-foot channel project created serious overcrowding. Eventually, several offices had to be quartered in local hotel rooms.

Two solutions which suggested themselves first were a new federal building or an extension of the existing one. The Rock Island Federal Building was a U-shaped structure; it would have been possible to fill in the middle of the U and then add two stories on top of that; but a new building would take years, while even the addition would require two years — time the growing project did not have. The first of the locks and dams on the project, Locks and Dam 15, was already under construction.

The solution was an abandoned arsenal storehouse on Arsenal Island, just a few hundred feet

from the locks and dam construction site, and 300 feet from the site of old Fort Armstrong. Storehouse A, as it had been originally known, had been a landmark in the area for many years. Residents in the Davenport-Rock Island area called it the Rock Island Clock Tower Building from the clock in the tower, whose four 12-foot faces were visible from much of the surrouding area. Since 1868, when the precision clockworks were installed, generations of visitors had climbed the six stories to watch the mechanism tick off almost perfect minutes, and to scrawl their names and dates along the walls of the top two stories of the tower.

The Rock Island Clock Tower Building was built by the Ordinance Department of the United States Army between 1863 and 1868 as the first building of the newly-authorized Rock Island Arsenal, designed to equip Union soldiers who were guarding the Mississippi against Confederate forces. The building was one of three arsenal storehouses built from the same plans, the others being at Columbus, Ohio, and Indianapolis, Indiana. All three buildings are still standing today; the other two have both become technical high schools.

The Union forces it was designed to serve were disbanded before the first floor was finished. Before the shell was half up, Major T.J. Rodman (afterwards brevet brigadier general), the second commandant at the Arsenal, moved the remaining arsenal construction toward the center of the island. Although the construction of the building was completed in 1868, Storehouse A was already obsolete and remained outside the gate of the new Rock Island Arsenal.

From 1871 on, the building was used to store arms, but its importance diminished as the main arsenal grew. Sometime before World War I the Army ordered it torn down. It was saved only in response to local sentiment and kept, as a later commandant, Colonel D.M. King, wrote, "chiefly as a relic."[1] By 1930 the Arsenal had moved its storage facilities elsewhere, leaving the Clock Tower empty.

The Clock Tower Building was spacious and sturdy enough for offices. The main building was 180 by 60 feet and contained three stories in addition to an attic and basement. The three floors contained about 35,000 square feet of space designed to sustain 270 pounds per square feet. The floors were covered with a double layer of oak and white pine. The shell of the building was built of Le Claire limestone, with a foundation 4 feet thick, while the first floor walls are 3 feet thick and the remainder of the walls above that 2½ feet thick. The estimated cost of the completed structure in 1868 was $200,000.[2]

The tower was the last part to be built. This 34-foot-square stone structure stood six stories high and served not only to house the clock on the sixth floor, but also to serve as a hoist which lifted supplies and stores up to the three main floors. Horses pulled wagons through the arched openings in the base of the tower to unload.

The clock, however, had come to be the main feature of the tower by 1930. The four unique clock dials which General Rodman installed on the tower are wooden faces 12 feet in diameter. Around the center in a 6-foot circle are 12 glass portholes at the hour points. Near the edge of the dial an arrangement of "stars and bars" mark off the hours, with stars representing the hours of 3, 6, 9, and 12, and bars representing the remaining hours. At the edge of the dials small raised bars mark off the minutes. The dials and markings were of wood, as were the carved wooden hands. The hands and markings were painted white to set them off from the black dial.

General Rodman ordered the clockworks from A.S. Hotchkiss of New York, a nationally known clock maker. The works were made at the Hotchkiss shop in Williamsburg, New York. The clockworks sit today where they were installed in 1868, along the east wall of the sixth floor of the tower. They sit in a solid frame of cast iron supported by four iron columns. A system of rods and gears running from the works to the center of the room and from there to the four dials runs all four sets of clock hands.

The pendulum hangs down through two stories of the tower. Its wood shaft and 350-pound ball vibrate every 3 seconds. The clock works run so smoothly that only a 150-pound weight is needed to drive the time, with 250 pounds needed to operate the striking mechanism, in contrast to the 700 pounds of weights usually needed for clocks of this size.[3]

The clock was originally wound by hand, a job that took two men 20 minutes once each week. On the wall of the clock room, among visitors' scrawls and the dates of times when repairs were made, is an entry dated July 7, 1907, which reads: "Carrie Passig and daughter Ruth and Hattie Pratt came with Papa (W.J.) Pratt to see him wind the clock. Papa started to wind clock in 1867 and missed winding three times in 1867 to 1907."[4]

In 1950 on an experimental basis the clock was switched to electric winding. In 1955 electricity was installed permanently. Otherwise, the clock still has all its original parts and still works well. A trip to view the works is a one of the "musts" for visitors to the Rock Island District Office. At one time the clock may have had an identical twin installed by Hotchkiss in a New York church, but today it is the only known clock of its type still running.

The move of the Rock Island District to this new office was gradual. In order to alleviate overcrowding at the Federal Building and in order to be close to the construction site of Locks and Dam 15, the Corps of Engineers obtained the right of temporary occupancy early in 1931. Using money from the appropriation for "Maintenance and Improvement of Existing River and Harbor Works, Mississippi River between the Illinois River and Minneapolis," the Rock Island District built temporary partitions at the east end of the first floor for an office, a drafting room, two instrument and miscellaneous storage rooms, and a lavatory. A concrete laboratory and an office were built along the west end of the first floor. On April 12, 1931, the field office personnel for Locks 15 inspection force moved into these quarters.[5]

For the next two years, the movement to the Clock Tower Building was regarded as temporary. In August of 1931 a photo lab was built along the northwest corner of the first floor. Four offices, a drafting room, and two lavatories were built on the second floor. These latter offices were built for the Dam 15 Davenport Interceptor Sewer and Seawall project. Personnel moved into these quarters on January 2, 1932.

The original storehouse building, in addition to having no partitions, had no provisions for heat or water. In September 1931, realizing that winter was coming on, the Corps let out bids on a heating plant, but only for one large enough to heat those offices already built, and to provide water for the photo lab.

When the field inspection force for Dam 15 moved into its second floor offices in January 1932, the third floor became a storage area for Locks and Dam 15 and Lock 20 operating machinery patterns, and for cores from test hole boring for lock and dam sites in the District.

For a brief time the third floor had a more interesting use. With its open area free of columns (the ceiling of the third floor was suspended from the attic girders), its high ceiling and wood floor, it became an ideal court for the District basketball team. In 1932 the Deputy District Engineer Captain Silkman provided funds to sand the floors, protect the windows, and install basketball hoops. Here, until some time in 1933, the District team played and practiced as a member of the Davenport YMCA Basketball League.[6]

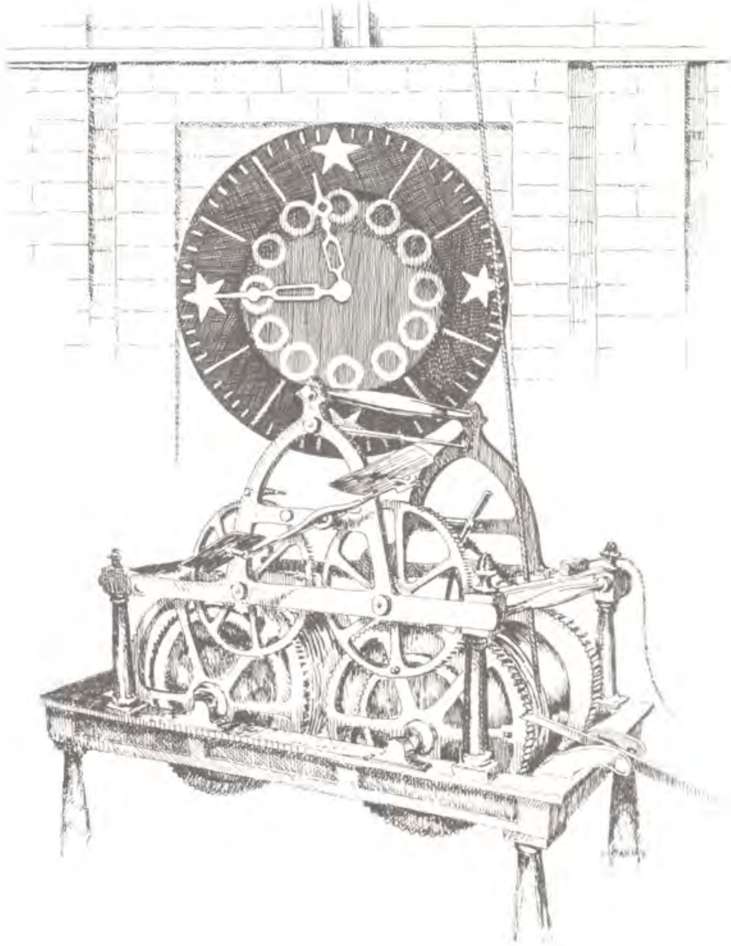
Expansion into the basement area of the Clock Tower Building began in October of 1932 when a concrete test cylinder storage room was built for the concrete laboratory. In 1933 the second floor (except for the four offices that were already there) became a large drafting room for 200 District draftsmen.[7] This lasted only until September when the greatly expanded Planning Section moved from its inadequate offices in the Safety Building.

Bit by bit, the occupation of the building grew. A larger boiler for heat had to be installed. To counter the increased fire hazard, steel fire escape ladders were installed outside the east and west ends of the building, and fire extinguishers and fire hoses were added inside.

At some point during late 1933 or early 1934, a decision was made to gradually transfer the district office itself, not just the overflow, from the Federal Building to the Clock Tower Building. That decision had to be made one way or the other because, as the building stood, it would serve as no more than temporary quarters, even for the overflow. The plumbing was not adequate, the heating plant had reached its capacity, floors and window sills and sashes were in bad shape. Roof and truss timbers had weakened to the point where the attic floor was supported by temporary wooden props on the third floor. Access to the floors was limited to the old hoist in the tower a small internal hoist, and two stairways on the side of the building opposite the tower, while outside, parking was rapidly becoming a major problem.

Once the decision had been made to move the Rock Island District to the Clock Tower Building, renovation began in earnest. 1934 became the year of the big move. During most of 1934 the regular work of the District was constantly interrupted by moving, by changed plans, and by the sounds of remodeling. As much of the work as possible was done during the second and third shifts to avoid disturbing District employees, but some of it was done with three shifts around the clock to hurry the work.

The city of Rock Island, as might be expected, was not happy over the proposed move. The Rock Island District Office had been located in Rock Island in three different buildings since 1872. On October 18, 1934, several members of the Rock Island Chamber of Commerce took the opportunity of a visit to the new Locks and Dam 15 by Secretary of War George Dern to plead the case for keeping the District Office in Rock Island, but by then it was too late.[8]



The clock works which many visitors climb the tower to see each year.

On February 6, 1934, the Hydraulics Section moved from the Federal Building to the northeast corner of the first floor of the Clock Tower Building. Two other major renovations were begun and completed during February and March: a larger freight elevator and a fireproof vault for valuable papers. Renovations continued for the remainder of the year. In the spring a parking lot was added outside the building, and quickly expanded when the first lot proved too small; electric fans were installed in offices as summer approached; the old oak flooring, much of it in splintered condition, was resurfaced and tiled; an elevator and a new steam heating plant were installed; and all sashes were repaired and painted.

The official move of the District to its new headquarters began in late November of 1934. Following resurfacing and tiling of the third floor, partitions and offices were completed, and on November 30, the Lands, Maps, Contract, and Purchase Sections moved into these quarters.

December 10, 1934, became the official date of the transfer of the Rock Island District from the Federal Building to the Clock Tower Building when Major Raymond A. Wheeler moved into his office on the southeast corner of the first floor. When he entered his office, Major Wheeler "found his desk adorned with a huge basket of flowers and a pretentious desk set — both being gifts from the engineer employees. The set included a desk blotter, electric clock, lamp, and letter opener."[9] By the end of December the entire District Office had left the Federal Building except for the Northern Field Area Office, the Illinois and Mississippi Canal Office, and the Property Section, all of which moved to the Clock Tower Building in 1936.

The Clock Tower Building provided more advantages for the Corps than space. On the morning of March 15, 1935, District employees were given a recess from work to watch a large ice flow pass through the rollers of Dam 15, a relatively new experience for area residents.[10]

The Corps of Engineers rented the Clock Tower Building until September 11, 1941, when the Ordnance Department permanently transferred ownership of the Clock Tower Building together with a surrounding triangle of 6.90 acres of land from the Rock Island Arsenal to the Corps of Engineers. With this transfer, the Rock Island District joined a select company of only two other Engineer districts who own their own buildings.

This ownership is signified by the castellated towers of the Corps' official insignia, in the form of two 5-inch by 8-inch bronze (gun metal) plates attached to the two south doors of the Clock Tower Building, and by a bronze plaque on the south wall

identifying the building as the District Engineer's Office. These were cast at the Rock Island Arsenal in 1935.

Although the outside of the building had changed little since 1935, the three floors, as well as basement and attic, have undergone periodic remodeling, both to update facilities and to squeeze ever more office and storage space out of corners here and there. The attic contains primarily storage space, though offices are beginning to appear there, too, while a lunch room and many offices have been added in the basement to make room for the more than 280 employees who presently work in the building.

In 1941, in response to the growing District motor fleet and its need for service, a motor shop and engineer depot was built just west of the Clock Tower Building. Parts of this building eventually housed a paint laboratory. Today the building serves as offices for the automatic data processing center, comptroller and finance and accounting offices, the procurement and supply division, the foundations and materials branch, and two conference rooms.

Offices and equipment throughout the building are constantly undergoing modernization. Beginning with a World War II AM radio system in the early 1940's, used only to communicate with the District dredge, District radio expanded in the early 1950's to AM radio connections with its locks and dams. In February 1965, just prior to the record flood of that year, the Clock Tower Building switched to shortwave, installed in a radio room on the third floor. District radio can now reach employees throughout the District in car, boat, or lock.

The old photo lab and mimeograph room would hardly recognize their modern up-to-date counterparts. Xerox equipment, beginning with a modest installation in 1963, has revolutionized the duplicating process. New equipment in the photo lab has made possible color work since 1967. A word processing center and a District Library begun in 1975

have helped personnel keep up with the information explosion. Today, the Clock Tower Building has become the symbol of the Corps of Engineers in the Rock Island District, and is leading a fuller and more active life than its original designers ever planned.

Notes

Appendix C.

1. Colonel D.M. King, *War's Greatest Workshop, Rock Island Arsenal* (Arsenal Publishing Company of the Tri-Cities, 1922), p. 77.

2. Rock Island *Argus*, November 5, 1866, p. 2.

3. *Argus*, January 7, 1868, p. 2.

4. Rock Island District mimeographed pamphlet. Rock Island District Historical Files.

5. War Department, Corps of Engineers, "Alterations of Clock Tower Building and Construction of the District Office Boathouse," typed copy (Rock Island, IL: U.S. Engineer Office, 1937).

6. Interview with John Sullivan, retired employee, drafting section, June 5, 1974.

7. *Argus*, December 30, 1933.

8. *Argus*, October 19, 1933.

9. *Argus*, December 10, 1934.

10. *Safe Channel*, 2 (April, 1935).

Appendix D

The Bicentennials and the Rock Island District

The United States Army Corps of Engineers was formed by the Second Continental Congress on June 16, 1775, to aid in construction of fortifications. As a result, the Corps Bicentennial came in 1975, a year earlier than the American Revolution Bicentennial in 1976. These two celebrations gave the Rock Island District a long period in which to commemorate the achievements of the Army Engineers and of the United States, and to bring these achievements to the attention of the public.

The official period for the Corps Bicentennial in the Rock Island District ran from June 15, 1975, to December 31, 1976; the National Bicentennial observances ran from July 1, 1976, to December 31, 1976.

In order to plan activities for the two celebrations, the District called together a Rock Island District Citizen's Committee in August 1974. This committee of prominent local citizens was chaired by Lieutenant Colonel Bernard P. Slofer, Deputy District Engineer. It was actually a reorganization of an earlier citizen's committee established in 1966 to help the District celebrate its own centennial. The Citizen's Committee planned events for both 1975 and 1976, and coordinated these with Corps activities at the divisional and national level.

Observance of the Corps Bicentennial began early in 1975 when a speakers' bureau was formed to bring the story of the Corps to interested groups in the District. Late in 1974 restoration work began on the three-panel mural in the first floor corridor of the Clock Tower Building. The mural, painted in 1943 by District employee Henry W. Lage, depicts

several military buildings constructed by the District during World War II; the last District snagboat *General Barnard;* and the first Rock Island District Office in Keokuk, Iowa. Professional artists cleaned, strengthened, and restored the mural.

A second addition to the Clock Tower Building in 1975 was the erection of a Bicentennial Fence along Rodman Avenue north of the building. This iron fence was cast at the Rock Island Arsenal in the 1870's, and originally surrounded part of the National Cemetery on Arsenal Island. The fence, made from melted-down Civil War cannon balls, depicts an oak leaf motif, with eagles on the fence posts.

In addition to the 170-foot section along Rodman Avenue, a second section of the fence was placed on the south side of the Clock Tower Building in 1976. This section of fence contains a new Rock Island District headquarters sign and a metal plaque telling the history of the fence. Other badly damaged sections of fence were individually mounted on walnut plaques as Bicentennial momentos.

In May the first official story of the Rock Island District, *A History of the Rock Island District Corps of Engineers, 1866-1975,* was published as a Bicentennial event and distributed to libraries and schools in the Rock Island District, as well as to Corps employees.

During the spring of 1975 the District planned and built a portable map exhibiting features of the Upper Mississippi River and identifying important activities of the Army and the Corps of Engineers along the river. Included were the Rock Island Arsenal, Fort Armstrong, and the Confederate Cemetery on Arsenal Island. This exhibit was shown at county fairs and numerous other events during 1975-76.

Each June 16 the Corps celebrates Engineer Day, but June 16, 1975, marked the special occasion of the Corps' 200th anniversary. On Friday afternoon, June 13, the Rock Island District held open house at all locks and dams. On June 16, in addition to the

usual ceremony, awards, and District picnic, five outstanding former employees were inducted into the District Gallery of Distinguished Civilian Employees. They were Frank W. Ashton, Carleton E. Kelley, Robert E. Clevenstine, Frederick A. Hansen, and Wallace E. Turpin. Portraits and brief biographies of these and other former employees now hang in the first floor corridor of the Clock Tower Building, representing the dedication and service for which the Rock Island District has long been noted.

The high point of the Corps Bicentennial began on August 1, 1975, when the *Sergeant Floyd* arrived in the District for a three-day stop at Quincy, Illinois. Built in 1932 by the famous Howard Shipyards at Jeffersonville, Indiana, the *Sergeant Floyd* was used for many years as a tow and workboat on the Missouri River by the Kansas City District Corps of Engineers. The boat was named for Sergeant Charles Floyd, an engineer soldier on the Lewis and Clark expedition in 1804. He was the only fatality on that expedition, the first soldier to die in the Louisiana Territory.

Originally a powerful boat with two 600-horsepower diesel engines, a 138-foot steel hull with a 4½-foot draft, and a wooden superstructure, the *Sergeant Floyd* had been outclassed by more modern vessels and was on the point of being decommissioned when Congress authorized her use as a Corps of Engineers floating museum.

At a cost of $300,000, the boat was remodeled into a museum housing old maps, photos of early river scenes, and steamboat memorabilia, and a series of multi-media displays on the many activities of the Corps of Engineers: the Panama Canal construction, water resources, hydroelectric power, and wildlife management. Highlight of the *Sergeant Floyd* displays was a 50-seat theater showing a 20-minute multi-media program on the history of the Corps, using six synchronized screens and projectors and 1,000 slides.

Ahead, the *Sergeant Floyd* pushed a 25-foot by 100-foot barge outfitted with a railing and canopy

The *Sergeant Floyd*, a Kansas City District towboat refurbished as a Corps of Engineers floating museum for the Bicentennial of the Corps, hosted record numbers of visitors at its stops in the Rock Island District.

for use by communities along the way to display their own Bicentennial material. She spent 10 days in the Rock Island District on her way to St. Paul, from August 1 to 11, and another nine days on the return downriver, stopping at cities and towns missed on the way up. On board the boat while it traveled through the Rock Island District were several crew members supplied by the District, including representatives of the Public Affairs Office, who served as exhibit guides and answered questions about the District.

The most successful stop in the Rock Island District came at Dubuque, Iowa, where the whole city had gone out of its way to welcome the boat with banners, crowds, bands, and a cocktail and dinner

party. As it approached Dubuque, the *Sergeant Floyd* was met by the U.S. Coast Guard vessel *Wyaconda* and a flotilla of large and small private craft, and escorted into the Dubuque harbor.

On Sunday, August 10, a record 5,042 visitors passed through the exhibits aboard the boat. This set a record for the largest number of visitors in a single day which was not broken during the rest of the *Sergeant Floyd's* travels. More than 23,800 people toured the boat while it was in the Rock Island District.

With its canopied barge in front, the *Sergeant Floyd* traveled more than 20,000 miles of the Nation's inland waterways until December 1976. It visited more than 250 communities and told the story of the Corps of Engineers to 550,000 people. Today, it is permanently docked at the St. Louis waterfront, continuing its public relations efforts as a Corps museum and exhibit.

So successful was the visit of the *Sergeant Floyd* that the Rock Island District created its own traveling display for the 1976 Bicentennial. The District exhibit was installed on a site inspection barge (from the old Illinois and Mississippi Canal) fitted with pipe railing and red canopy, and pushed by one of three District towboats. From May 29 through October 2, the exhibit visited area communities on weekends and was eventually seen by more than 16,000 people.

On Engineer Day, June 16, 1976, the Rock Island District was officially named a Bicentennial Installation by the American Revolution Bicentennial Administration because of the many events it had planned for 1975 and 1976. A Bicentennial flag was presented to Colonel Lycan and flown beneath the American flag at the Clock Tower Building.

1976 was not as full of Bicentennial activities as 1975 had been, but the District did continue the good public relations efforts it had begun. Smaller exhibits were shown at local boat and camping shows, at local fairs, and at the Iowa State Fair, a

practice that still continues. These Bicentennial events were successful in calling the public's attention to the many activities of the Rock Island District; they helped make the public aware of the Corps' continuing responsibilities on the Upper Mississippi River.

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By far the largest number of records in this category are in the collection, Textual Records of the Office of the Chief of Engineers, Record Group 77, National Archives. Documents relating to the Office of the Chief of Engineers, including the many volumes of *Letters Received by the Chief of Engineers* between 1826 and 1886 are located in the National Archives Building in Washington, D.C., and at the Washington National Records Center at Suitland, Maryland. Collections relating specifically to the Rock Island District, including entries 1651 through 1684, inclusive, from the "Preliminary Inventory" by Maizie H. Johnson, are located in the Federal Records Center, Chicago, Illinois, as are the Chicago District Records relating to the improvement of the Illinois River and construction of the Illinois and Mississippi Canal. A few scattered Rock Island District Records are also located in the "Old Rock Island File" at the Federal Records Center, Kansas City, Missouri. The private papers of Major Gouverneur K. Warren, including journals and drawings of his surveys of the Upper Mississippi and the Rock Island Rapids, are located at the State Library of New York in Albany.

The remainder of the unpublished sources come from the Historical Files of the Rock Island District, including a large photograph collection and additional records of the Illinois and Mississippi Canal, and the Historical File of the Keokuk Public Library, Keokuk, Iowa.

Taped interviews with several present and retired employees of the Rock Island and St. Paul Districts proved to be a significant source of information.

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Addendum 1981-1983

Three significant events occurred during the period between 1981 and 1983 while Colonel Bernard P. Slofer was District Engineer.

They were the water supply contract for Saylorville Lake; the final lump-sum seepage payment to the Sny Island Levee and Drainage District; and the District assuming navigation responsibilities for the Chicago Sanitary and Ship Canal.

Water Storage Contract, Saylorville Lake

The District executed a water storage contract between the Federal Government and the State of Iowa in 1982. The contract provided the State of Iowa 14,900 acre-feet of storage space in Saylorville Lake, Iowa. This storage space provides an average flow of 75 cubic feet per second with a 99 percent reliability for municipal and industrial water supply purposes.

It was necessary to raise the conservation pool 3 feet to maintain reliability for other project purposes. The contract was precedent-setting because it was the first time the Corps of Engineers raised a conservation pool for the purpose of providing water supply.

The storage space is totally subcontracted to two utilities; the Des Moines Water Board, Des Moines, Iowa, and Iowa Southern Utilities, located near Ottumwa, Iowa. These two utilities financed the entire water supply cost with up-front funding to support the specific construction cost due to raising the conservation pool. In addition, they will annually provide the Federal Government funds for the water supply share of initial project cost and operation and maintenance costs over a 25-year period.

Mitigation efforts included a construction contract to modify three recreation sites, historical/cultural investigations to survey and recover archaeological artifacts, and additional easement lands. Saylorville Lake became operational for water supply purposes in 1983.

Sny Seepage Payment

Federal Government lump-sum payments to levee and drainage districts along the Upper Mississippi River were authorized in 1958, to compensate them for seepage damages from the lock and dam system on the river. These payments have been made.

Seepage damages were not paid to the Sny Island Levee and Drainage District because that district's Mississippi River levee had not been completed. A later study concluded that the Sny District was not entitled to seepage damage payments, but that certain identified lands within the Sny District were damaged and should have remedial works provided to alleviate the seepage conditions.

The Corps of Engineers paid the Sny District $2,146,800 in December 1982, as a final settlement of this matter, with the Sny District acting as the responsible agent to correct the seepage problems in conjunction with the affected landowners. Agreements in this final settlement involved agreements between the individual landowners and the Sny District which were separate from the basic agreement between the Federal Government and the Sny District.

Chicago Sanitary and Ship Canal Navigation

On December 4, 1981, Congress passed legislation (Section 107 of Public Law 97-88) authorizing the Corps of Engineers to operate and maintain the Chicago Sanitary and Ship Canal in the interest of navigation. This canal is a multi-purpose waterway constructed by the Metropolitan Sanitary District of Greater Chicago in 1904. The canal serves the purposes of hydro-electric power, flood control, sanitary discharge, and navigation.

Since the congressional authority extended only to navigation, extensive negotiation and coordination were required to reach agreement with the Metropolitan Sanitary District on the functions which serve navigation. Subsequent congressional action added clarification to the original authority.

In October 1983, negotiations were concluded on a Memorandum of Agreement between the Corps of Engineers and the Metropolitan Sanitary District of Greater Chicago on the division of responsibilities for the canal. Because many of the structures serve more than one purpose, the final agreement was a compromise that attempts to distribute the responsibilities in an equitable manner.

The result was that the Rock Island District assumed responsibility for all navigation and related maintenance and operation between La Grange, Illinois, (River Mile 80) and Lake Michigan at two points; the Calumet Sag Channel near the Indiana border and the Sanitary and Ship Canal through downtown Chicago.

The operation and maintenance of the Chicago River Lock to Lake Michigan was given to the Chicago District since it was included in the area of the deep draft project.

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